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SIMPLE

ELEMENTS OF NAVIGATION.

BY

LUCIEN YOUNG,

U. S. Navy.

SECOND EDITION, ENLARGED.

FIRST THOUSAND.

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PREFACE.

THIS little work is not intended to supply any presumed deficiency in other books treating of the same subject, but to preserve one common method throughout and to omit all complicated mathematical formulæ and calculations beyond the reach of men of limited education.

The most simple elements of navigation only are treated of, and the tables added to make the little work complete in everything necessary to navigate a vessel to any port of the globe.

By a study of no other instructions than those contained in this little treatise, the nautical apprentice can soon fit himself for promotion; the merchantman make himself competent to conduct his vessel to his destination; and the owner of a yacht, with a little trouble, become able to co-operate with his captain. Other works are intended for the use of accomplished mathematicians or experienced navigators.

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PREFACE TO SECOND EDITION.

THE success which has greeted the first edition has led the author to make certain additions to the Second Edition which will serve to increase its usefulness.

A chapter on "Compass Adjustment" and one on "General Examples for Exercise" will be found in this edition, as well as an article giving short instructions for the "Relief of the Sick and the Wounded." Some typographical errors have been corrected, and it is hoped a new value has been given to the work.

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SIMPLE ELEMENTS OF NAVIGATION.

CHAPTER I.

DESCRIPTION AND USE OF INSTRUMENTS.

Definitions. NAVIGATION is the science which treats of the determination of a ship's position at sea and the particular direction a vessel should steer to reach any given place. It may be said to consist of two kinds:

Firstly, the science of navigation by which the position of the ship is determined from day to day by referring it to some other geographical spot, such as a known landmark, a determinate bottom, or a previously defined place.

Secondly, the science by which the position of the ship is determined from observations of the heavenly bodies.

The voluminous works on this subject are full of difficult and complicated calculations, which only an expert mathematician can understand. They are beyond reach of the class of young men of limited education, who enter an apprenticeship either in the merchant marine or the naval service. Moreover, these works are filled with many methods by which the same problem is solved, embarrassing to the beginner instead of instructing him.

In order to simplify this as much as possible it is proposed to imagine a vessel in port with everything stowed ready for sea, and to confine the problems to the most common methods in her voyage to some other port across the ocean.

Use of Instruments. The first thing to do on going on board is to become acquainted with the use and application of such instruments as are necessary to determine the distance which the ship sails, the direction in which she is steered, and

to deduce, from the data these instruments furnish, the situation of the ship at any time, and to find the distance and direction of any place to which it may be required that the ship should be taken.

Hand-lead is used to obtain soundings in shallow water, with a view of safely guiding the ship over shoals, through channels to an anchorage, or to sea; it is in weight ranging from five to fourteen pounds.

Deep-sea Lead is used to obtain soundings in deeper water and to ascertain the nature of the bottom; it is in weight ranging from twenty-five to one hundred pounds; is hollow at the bottom, for placing a lump of tallow called the **Arming**. The nature of the bottom is indicated by the portion of the bottom brought up in the arming.

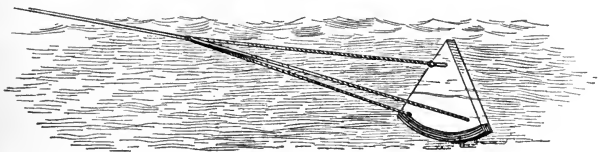
In heaving this lead the headway of the ship must be checked to get a cast; to obviate this many ingenious instruments have been invented by which the soundings can be taken from a ship running at full speed, in water of any depth not exceeding one hundred and fifty fathoms (a fathom is six feet). Some of these instruments register the depth of water descended through by wheel-work set in motion by a fly, and others by the condensation of air contained in a glass tube by the pressure of water; but the most common one in use is the Thomson sounding-machine, which has a glass tube connected with a sinker, closed at the top and coated inside with chromate of silver; the increased pressure at greater depths drives the water up the tube, and its action leaves a white mark, the position of which is estimated by a scale, and it is independent of the amount of line run out. A small steel wire is used instead of a line, and is coiled on a light reel.

Log and Glass are used to measure the rate of sailing, and a timepiece to note the interval. The log consists of several parts—chip, bridle, line, and reel.

Log-chip is a thin piece of wood, in the form of a sector of about five inches radius, weighted on the circular edge with lead sufficient to make it swim upright in the water.

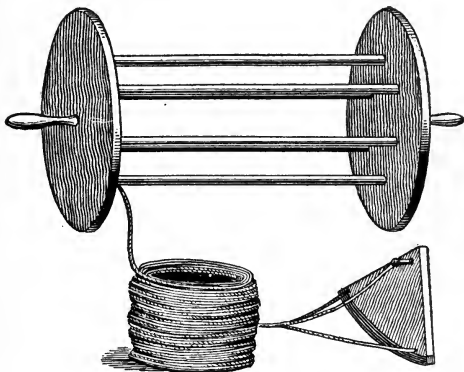
At each of the three corners is a hole, through two of which legs of the bridle are rove and knotted; the third leg has a peg of wood in the end, which, when the log is hove, is firmly pressed into the unoccupied hole: it remains thus while the line is running out, and pulls away when the line is being

hauled in. The legs of the bridle are about two feet long, and bent to the outer end of the log-line.



LOG-CHIP.

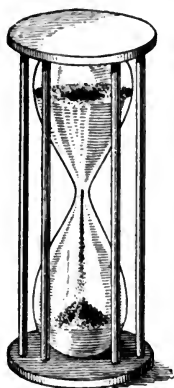
Log-line is a small line of about 150 fathoms long, one end attached to the bridle and the other fastened to a “reel,” over which the log-line is wound. At about 15 fathoms from



LOG-REEL.

the chip a white rag is placed to mark what is called the “**stray-line**,” which permits the chip to clear the wake of the ship or swash of the propeller. From this rag inboard the line is divided into equal portions by bits of small line through the strands of the log-line, and designated by the number of knots in each; hence are called knots. The length of each of these divisions of the line bears the same ratio to the nautical mile that the glass does to an hour. The division of the line between the knots is divided into tenths, marked by a small string.

Log-glass is an ordinary sand-glass constructed so as to permit the sand to run from one end to the other in a certain time: those in common use are the long-glass, which requires 28 seconds, and the short-glass, 14 seconds, to run through. The line is graduated for the long-glass, and when the short-glass is used the knots indicated should be doubled.



LOG-GLASS.

Heaving the Log. The using of these is called heaving the log. One man holds the reel in a horizontal position and another holds the glass with the sand down, while a third takes the log-chip and presses the peg into its place, then unwinds a quantity of line, and holding it faked in his hand, calls "**Clear glass,**" repeated by the man holding the glass.

The one with the line throws the chip over the lee quarter to clear the wake, and permits the line to run freely through his hand, feeding and checking if necessary, and when the white rag passes his hand he cries out "**Turn;**" the glass is then turned. The glass-holder answers **Turn,** and holds the glass up so as to permit the sand to run through. The moment the sand is run out the glass-holder calls out "**Up,**" when the line is checked and the knots and tenths indicated. The log is hove every hour, and should be whenever the course is changed.

Log Adjustments. The log requires to be frequently adjusted, when the peg should be examined and found to fit sufficiently tight. The log-line shrinks unequally, and requires to be frequently verified. A convenient method is by having nails placed in the deck at proper distances to measure from, the line being wet at the time. In damp weather the sand in the glass becomes wet, and is not only retarded, but often hangs altogether: when this is the case the cork stopper in the end is removed, the sand taken out and replaced by dry, or the quantity of sand can be reduced or increased in this way when the glass is in error. The glass-error is found by comparison with the second hand of a watch or a small second-pendulum. A pendulum for comparison can easily be constructed

by having hung from a nail a small bullet by a thread $38\frac{1}{2}$ inches long from the centre of the bullet to the nail.

Many and most efficient patent logs have been devised, and have been found very accurate, and have been frequently substituted for the common log; however, one acts as a check on the other, and both should be used. The most common of these is the **Taffrail Log**, which consists of a rotator or fly towed astern clear of the wake by a line, and the register is attached to the taffrail. As the fly is drawn through the water in a horizontal position, the motion is communicated by means of the connecting cord to the wheel-work within the register, and sets in motion the indices. By this means the rate of the ship can be read off at any time by simply going to the rail and noting the interval it takes the dial to make one mile.

Ground-log is a log adapted for use in shoal water to ascertain when in doubt the set of the current; it consists of a small lead and a line divided in the same manner as the common line. When hove, the lead remains on the bottom and the line gives the combined motion of the ship through the water and that of the current.

Compass denotes the direction sailed, and indicates the future course. The compass is simply an instrument which utilizes the directive powers of the magnet.

Card and Needle. The essential part of the mariner's compass consists of a circular card upon which are marked the various points, and is carried by a magnetized needle placed under the line joining the north and south points.

The needle is freely balanced upon a fine pivot rising from the bottom of a brass or copper bowl by means of a small agate cup fixed in the centre of the needle.

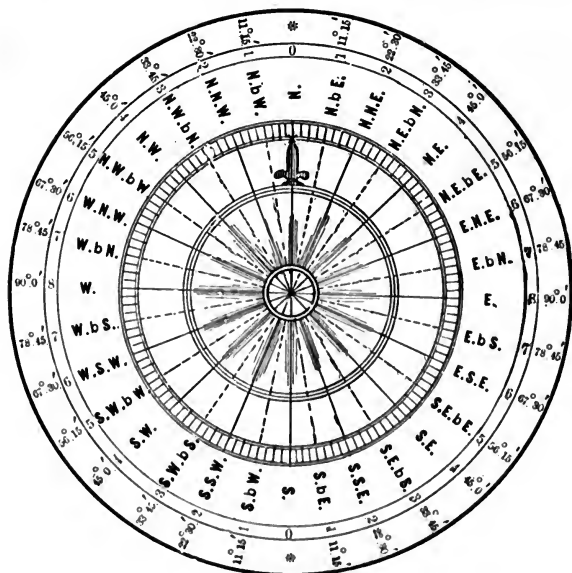
Compass Bowl, containing the needle and card, is carried on gimbals, so that it may at any time remain level in whatever direction the ship may roll or pitch. The bowl has a glass cover, and is fitted to carry lights to illuminate the face of the card at night. This case and stand is called the **Binnacle**.

Lubber's Point. Inside the bowl is painted a black vertical line, commonly called the *lubber's point*. The centre of the compass card and this lubber's point should be in a line with the keel of the vessel, and the point marked on the card

the ship is to be steered should be kept coincident with this point.

Points of the Compass. The compass card is divided into four quadrants by two diameters perpendicular to each other; the ends of these diameters are called *north*, *south*, *east*, and *west*, and are marked N., S., E., W.: they are termed the "**Cardinal points.**" Each of these quadrants is divided into eight equal spaces or points; hence there are thirty-two points to the compass. These thirty-two points are in turn subdivided into half and quarter points.

The following figure will show the names of these points.



MARINER'S COMPASS.

The half and quarter points are indicated from any of the 32 points towards one of the cardinal points, thus: N. $\frac{1}{2}$ E. means half a point from the north towards the east. SW. $\frac{1}{2}$ W. means half a point from the southwest towards the west.

Boxing the Compass. The repetition of the names of these points consecutively is called boxing the compass.

The compass card is also divided into degrees for the convenience of taking bearings, and the following table will give the points, half and quarter points, with the corresponding degrees, from which they can be easily converted one to the other.

TABLE FOR CONVERTING POINTS INTO DEGREES.

| N. to E. | N. to W. | S. to E. | S. to W. | Points. | Degrees. |
|------------------------------|------------------------------|------------------------------|------------------------------|----------------|-------------|
| North | North. | South. | South. | 0 | 00° 00' 00" |
| N. $\frac{1}{4}$ E. | N. $\frac{1}{4}$ W. | S. $\frac{1}{4}$ E. | S. $\frac{1}{4}$ W. | $0\frac{1}{4}$ | 2 48 45 |
| N. $\frac{1}{2}$ E. | N. $\frac{1}{2}$ W. | S. $\frac{1}{2}$ E. | S. $\frac{1}{2}$ W. | $0\frac{1}{2}$ | 5 37 30 |
| N. $\frac{3}{4}$ E. | N. $\frac{3}{4}$ W. | S. $\frac{3}{4}$ E. | S. $\frac{3}{4}$ W. | $0\frac{3}{4}$ | 8 26 15 |
| N. by E. | N. by W. | S. by E. | S. by W. | 1 | 11 15 00 |
| N. by E. $\frac{1}{4}$ E. | N. by W. $\frac{1}{4}$ W. | S. by E. $\frac{1}{4}$ E. | S. by W. $\frac{1}{4}$ W. | $1\frac{1}{4}$ | 14 03 45 |
| N. by E. $\frac{1}{2}$ E. | N. by W. $\frac{1}{2}$ W. | S. by E. $\frac{1}{2}$ E. | S. by W. $\frac{1}{2}$ W. | $1\frac{1}{2}$ | 16 52 30 |
| N. by E. $\frac{3}{4}$ E. | N. by W. $\frac{3}{4}$ W. | S. by E. $\frac{3}{4}$ E. | S. by W. $\frac{3}{4}$ W. | $1\frac{3}{4}$ | 19 41 15 |
| N. E. | N. W. | S. E. | S. W. | 2 | 22 30 00 |
| N. E. $\frac{1}{4}$ E. | N. W. $\frac{1}{4}$ W. | S. E. $\frac{1}{4}$ E. | S. W. $\frac{1}{4}$ W. | $2\frac{1}{4}$ | 25 18 45 |
| N. E. $\frac{1}{2}$ E. | N. W. $\frac{1}{2}$ W. | S. E. $\frac{1}{2}$ E. | S. W. $\frac{1}{2}$ W. | $2\frac{1}{2}$ | 28 07 30 |
| N. E. $\frac{3}{4}$ E. | N. W. $\frac{3}{4}$ W. | S. E. $\frac{3}{4}$ E. | S. W. $\frac{3}{4}$ W. | $2\frac{3}{4}$ | 30 56 15 |
| N. E. by N. | N. W. by N. | S. E. by S. | S. W. by S. | 3 | 33 45 00 |
| N. E. $\frac{1}{4}$ N. | N. W. $\frac{1}{4}$ N. | S. E. $\frac{1}{4}$ S. | S. W. $\frac{1}{4}$ S. | $3\frac{1}{4}$ | 36 33 45 |
| N. E. $\frac{1}{2}$ N. | N. W. $\frac{1}{2}$ N. | S. E. $\frac{1}{2}$ S. | S. W. $\frac{1}{2}$ S. | $3\frac{1}{2}$ | 39 22 30 |
| N. E. $\frac{3}{4}$ N. | N. W. $\frac{3}{4}$ N. | S. E. $\frac{3}{4}$ S. | S. W. $\frac{3}{4}$ S. | $3\frac{3}{4}$ | 42 11 15 |
| N. E. | N. W. | S. E. | S. W. | 4 | 45 00 00 |
| N. E. $\frac{1}{4}$ E. | N. W. $\frac{1}{4}$ W. | S. E. $\frac{1}{4}$ E. | S. W. $\frac{1}{4}$ W. | $4\frac{1}{4}$ | 47 48 48 |
| N. E. $\frac{1}{2}$ E. | N. W. $\frac{1}{2}$ W. | S. E. $\frac{1}{2}$ E. | S. W. $\frac{1}{2}$ W. | $4\frac{1}{2}$ | 50 37 30 |
| N. E. $\frac{3}{4}$ E. | N. W. $\frac{3}{4}$ W. | S. E. $\frac{3}{4}$ E. | S. W. $\frac{3}{4}$ W. | $4\frac{3}{4}$ | 53 26 15 |
| N. E. by E. | N. W. by W. | S. E. by E. | S. W. by W. | 5 | 56 15 00 |
| N. E. by E. $\frac{1}{4}$ E. | N. W. by W. $\frac{1}{4}$ W. | S. E. by E. $\frac{1}{4}$ E. | S. W. by W. $\frac{1}{4}$ W. | $5\frac{1}{4}$ | 59 03 45 |
| N. E. by E. $\frac{1}{2}$ E. | N. W. by W. $\frac{1}{2}$ W. | S. E. by E. $\frac{1}{2}$ E. | S. W. by W. $\frac{1}{2}$ W. | $5\frac{1}{2}$ | 61 52 30 |
| N. E. by E. $\frac{3}{4}$ E. | N. W. by W. $\frac{3}{4}$ W. | S. E. by E. $\frac{3}{4}$ E. | S. W. by W. $\frac{3}{4}$ W. | $5\frac{3}{4}$ | 64 41 15 |
| N. E. | N. W. | S. E. | S. W. | 6 | 67 30 00 |
| N. E. by N. | N. W. by N. | S. E. by S. | S. W. by S. | $6\frac{1}{4}$ | 70 18 45 |
| N. E. by N. $\frac{1}{4}$ N. | N. W. by N. $\frac{1}{4}$ N. | S. E. by S. $\frac{1}{4}$ S. | S. W. by S. $\frac{1}{4}$ S. | $6\frac{1}{2}$ | 73 07 30 |
| N. E. by N. $\frac{1}{2}$ N. | N. W. by N. $\frac{1}{2}$ N. | S. E. by S. $\frac{1}{2}$ S. | S. W. by S. $\frac{1}{2}$ S. | $6\frac{3}{4}$ | 75 56 15 |
| N. E. by N. | N. W. by N. | S. E. by S. | S. W. by S. | 7 | 78 45 00 |
| N. E. $\frac{1}{4}$ N. | N. W. $\frac{1}{4}$ N. | S. E. $\frac{1}{4}$ S. | S. W. $\frac{1}{4}$ S. | $7\frac{1}{4}$ | 81 33 45 |
| N. E. $\frac{1}{2}$ N. | N. W. $\frac{1}{2}$ N. | S. E. $\frac{1}{2}$ S. | S. W. $\frac{1}{2}$ S. | $7\frac{1}{2}$ | 84 22 30 |
| N. E. $\frac{3}{4}$ N. | N. W. $\frac{3}{4}$ N. | S. E. $\frac{3}{4}$ S. | S. W. $\frac{3}{4}$ S. | $7\frac{3}{4}$ | 87 11 15 |
| N. E. | N. W. | S. E. | S. W. | S | 90 00 00 |

According to the purpose for which the mariner's compass is especially adapted it is named the *steering*, *standard*, and *azimuth* compass.

Steering Compass is the one placed in the binnacle near the wheel to assist the man at the wheel in keeping the ship's head in the prescribed direction.

Standard Compass is the one placed on a particular spot on deck or above it where the local influence of the iron in the ship is the smallest and to which the steering compass is always referred.

Azimuth Compass is the one mounted on a stand in some commanding position for the purpose of taking bearings, and is provided with a pair of sight vanes for observing objects. The standard compass is usually an azimuth compass.

Variation. The direction the horizontal needle assumes when uninfluenced by external causes is called the magnetic north, and at different times and places does not coincide with the true north. The difference between these two directions measured in degrees is called variation. It is said to be easterly when the north end of the needle is drawn to the eastward, and westerly when it is drawn to the westward, of the true north. The variation is found on the chart.

Deviation is the term applied to indicate the effect produced on the compass by objects within the ship, such as the ship being built of iron, laden with iron or having certain attachments made of iron, and local influences external to the ship. Vertical iron, such as boat-davits, iron stanchions, smoke-stack, etc., has the greatest effect when the ship's head is north or south and least when east or west; and the horizontal pieces of iron, such as deck beams, engine shafts, etc., will affect the compass most at the four points lying between the cardinal points and least at the north, south, east, and west points.

The introduction of iron in shipbuilding has rendered the question of deviation most important, and the amount will depend upon the direction in which the ship's head lies while building; if built with her head north or south she will receive a large amount of induced magnetism from the hammering necessary and from the earth. This magnetism once driven in, may be increased or diminished by grating against piers, striking sunken rocks, or being struck by a heavy sea.

It has also been found the deviation is different when the vessel heels over on either side, to what it is when she is on an even keel: in northern latitudes the compass needle is drawn to windward as the vessel heels over, and whenever the

vessel head is E. or W. the heeling error vanishes and is greater when it is N. or S.

The deviation changes when the ship proceeds to a different latitude, hence should be frequently ascertained and tables constructed by the process of swinging ship not only on an even keel, but also when the ship is heeled over to starboard and when heeled over to port.

To Find the Deviation. The standard compass is placed in its permanent position, and the ship is taken to some place in smooth water and caused to swing around that her head may be made to come to every point of the compass, and as she does the deviation is ascertained as follows:

I. By means of buoys the true bearings of which have been previously ascertained.

II. When in an open harbor where some fixed object at a distance of eight or ten miles can be clearly seen. Write down the points of the compass, and as the ship swings around from one point to another write down the compass bearing of the object opposite the point of the compass towards which the ship's head is directed. The mean of two bearings on east and west by compass, or the mean of all these bearings, will be the magnetic bearing of the distant object from the ship, the difference of which from each of the bearings will give the deviation for that point of the ship's head. It is thus that the majority of deviation tables are constructed.

III. When the ship is in a closed harbor and no distant object can be seen, a standard compass is taken on shore and placed in such a position as to be free from the influences of magnetic attraction, and where it may be seen. As the ship swings around the bearing of the compass on shore is observed from the ship as her head comes to each point, and at the same instant, indicated by signals, the ship's compass is observed from shore. The observations on shore are first reversed to bring them into the same direction as those taken from the ship, and are compared with the latter; the difference is the deviation. Should there be a suspicion of local attraction to the compass on shore a plane table may be used instead of the shore compass.

IV. When at sea or out of sight of land if a distant sail be in sight, advantage may be taken of a calm or light airs to swing

ship by it as in the second case or by the true bearing of the sun explained in Chapter X.

The deviation for the ship's head at each of the points of the compass having been obtained by any of the processes which have been described, a table of the results should be constructed, marking the deviation east when the north end of the needle has been drawn to the eastward, and west when it has been drawn to the westward, of the magnetic north. These tables should be constructed and made use of even though the compasses be or be not corrected by magnets or masses of iron as is the practice in iron ships.

The following is the form of a deviation table:

DEVIATION TABLE.

| Ship's head. | Deviation. | Ship's head. | Deviation. |
|--------------|------------|--------------|------------|
| North. | 2 20 E. | South. | 2 40 W. |
| N. by E. | 3 40 E. | S. by W. | 3 50 W. |
| NNE. | 5 40 E. | SSW. | 5 50 W. |
| NE. by N. | 6 50 E. | SW. by S. | 6 00 W. |
| NE. | 8 00 E. | SW. | 6 50 W. |
| NE. by E. | 8 10 E. | SW. by W. | 7 30 W. |
| ENE. | 7 20 E. | WSW. | 7 50 W. |
| E. by N. | 7 30 E. | W. by S. | 8 10 W. |
| East. | 6 40 E. | West. | 8 00 W. |
| E. by S. | 5 50 E. | W. by N. | 7 40 W. |
| ESE. | 4 30 E. | WNW. | 6 40 W. |
| SE. by E. | 3 40 E. | NW. by W. | 5 40 W. |
| SE. | 2 00 E. | NW. | 4 30 W. |
| SE. by S. | 1 00 E. | NW. by N. | 3 10 W. |
| SSE. | 0 30 W. | NNW. | 1 50 W. |
| S. by E. | 1 30 W. | N. by W. | 0 30 E. |

Leeway is an apparent error to which the compass is subjected, and is due to the pressure of the wind and surge of the sea driving the vessel to leeward, when close hauled, of the direction by compass it is intended she should sail. The amount depends upon the lines and trim of the ship, the draft and sails used, or whether the ship be as near the wind as she will lie. Leeway is estimated in points and quarter points by observing the wake astern. If the wind is on the starboard hand the leeway is to the left, and if on the port hand it is to the right.

Course of a ship and the **bearing** of an object are terms used with reference to the standard compass, to the magnetic meridian, and to the true meridian. The course of the ship by

the standard compass, which is affected by both deviation and variation, is called the "*compass course*;" the course with reference to the magnetic meridian, or the course which would be shown by the compass on board affected by variation only and not by the deviation, is called the "*correct magnetic course*." The course with reference to the true meridian is called the "*true course*." In the same way the bearing of an object may be distinguished as the *compass bearing*, *correct magnetic bearing*, or the *true bearing*, as the case may be.

In any conversion from one compass course to another, or from one compass bearing to another, whether the correction is made by applying the variation or the deviation, both corrections are applied to the right if easterly, and to the left if westerly. Similarly, where the conversion is from one true course to another or from one true bearing to another, both are applied to the right if westerly, and to the left if easterly. The method will appear in the following examples.

A vessel heads by compass NNE. $\frac{1}{2}$ E. The variation shown on the chart is $21^{\circ} 14' \text{ E.}$; find the true course.

The compass course NNE. $\frac{1}{2}$ E. or N. $28^{\circ} 07' 30'' \text{ E.}$

Variation E. $21 \ 14 \ 00 \text{ right}$

The magnetic course N. $49 \ 21 \ 30 \text{ E.}$

From table deviation for NNE. $\frac{1}{2}$ E. $6 \ 15 \ 00 \text{ E. or to right.}$

True course N. $55 \ 36 \ 30 \text{ E.}$

Again with the head of the vessel at ESE. the variation was shown on the chart to be $10^{\circ} 15' \text{ W.}$; find the true course.

From compass table ESE. is . . . S. $67^{\circ} 30' 00'' \text{ E.}$

Variation from chart W. $10 \ 15 \ 00 \text{ left.}$

True magnetic course S. $77 \ 45 \ 00 \text{ E.}$

Deviation for ESE. from table E. $4 \ 30 \ 00 \text{ right.}$

True course S. $73 \ 15 \ 00 \text{ E.}$

The variation being given by the chart may be considered as a constant quantity, but not so with the deviation, which may vary for every point of the ship's head. The frequent use of the deviation table might result in mistakes, to avoid which, it will be better to construct another table for the convenience of the compass course or bearing to convert to the magnetic course or bearing and *vice versa*. The compass

course or ship's head is written in the first column, the deviation in the second as found from the observations already described, and the magnetic course in the third column, thus:

| Ship's head. | Deviation. | Magnetic Course | Ship's head. | Deviation. | Magnetic Course. |
|--------------|------------|-----------------|--------------|------------|------------------|
| | ° / | ° / | | ° / | ° / |
| North. | 2 20 E. | N. 2 20 E. | South. | 2 40 W. | S. 2 40 E. |
| N. by E. | 3 40 E. | N. 14 15 E. | S. by W. | 3 50 W. | S. 7 25 W. |
| NNE. | 5 40 E. | N. 28 10 E. | SSW. | 5 20 W. | S. 17 10 W. |
| NE. by N. | 6 50 E. | N. 40 35 E. | SW. by S. | 6 00 W. | S. 27 45 W. |
| NE. | 8 00 E. | N. 53 00 E. | SW. | 6 30 W. | S. 38 30 W. |
| NE. by E. | 8 10 E. | N. 64 25 E. | SW. by W. | 7 30 W. | S. 48 45 W. |
| ENE. | 7 20 E. | N. 74 50 E. | WSW. | 7 50 W. | S. 59 40 W. |
| E. by N. | 7 30 E. | N. 86 15 E. | W. by S. | 8 10 W. | S. 70 35 W. |
| East. | 6 40 E. | S. 83 20 E. | West. | 8 00 W. | S. 82 00 W. |
| E. by S. | 5 50 E. | S. 72 55 E. | W. by N. | 7 40 W. | N. 86 25 W. |
| ESE. | 4 30 E. | S. 63 00 E. | WNW. | 6 40 W. | N. 74 10 W. |
| SE. by E. | 3 40 E. | S. 52 35 E. | NW. by W. | 5 40 W. | N. 61 55 W. |
| SE. | 2 00 E. | S. 43 00 E. | NW. | 4 30 W. | N. 49 30 W. |
| SE. by S. | 1 00 E. | S. 32 45 E. | NW. by N. | 3 10 W. | N. 36 55 W. |
| SSE. | 0 30 W. | S. 23 00 E. | NNW. | 1 50 W. | N. 24 20 W. |
| S. by E. | 1 30 W. | S. 12 45 E. | N. by W. | 0 30 E. | N. 10 45 W. |

To obtain the correct magnetic course from the compass course, look in the first column for the compass course, the second column gives the deviation when the vessel's head is on that point, and the third column will be found the magnetic course.

In order to correct any bearings taken by the compass the table is to be entered with the direction of the ship's head at that time in the first column, and corresponding thereto in the second column will be found the amount of deviation to be applied, as per example: If a ship's head is NNE. the bearing of two islands be SE. and W. by S. by the compass. In the second column of the table and opposite to NNE. the deviation is $5^{\circ} 40'$ E.; applying this deviation to the right the correct magnetic bearing of the two islands will be S. $39^{\circ} 20'$ E., and S. $83^{\circ} 55'$ W., or roughly in points SE. $\frac{1}{2}$ E. and W. $\frac{1}{2}$ S.

The Chart is used to plot the position of the ship at any time and refer it to other known objects. Its construction has especial reference to the requirements of navigation. Thus the chart may be required for coasting purposes, in which case the harbor or coast charts are used, upon which are marked with great accuracy, the rocks, shoals, local cur-

rents, nature of the tides, soundings and channels as well as the different aids to navigation and their bearings.

For off shore cruising the **Mercator Chart** possesses so many advantages that it is universally adopted for sea purposes.

For the purposes of navigation and in order that the relative positions of places on the earth's surface may be laid down and quickly found, certain lines are supposed to be drawn upon the sphere.

These imaginary lines of reference are called **Parallels of Latitude** and **Meridians**, and when these are known for any given place its position upon the globe is precisely determined by their intersection.

The extremities of the axes of the earth are called the **Poles**, and the great circles passing through these poles are called **Meridians**. It is customary with us to call that meridian which passes through Greenwich the **First** or **Prime Meridian**.

The great circle drawn around the earth at equal distance from the poles, and perpendicular to the meridians, is called the **Equator**.

The equator and the prime meridian are the first lines of reference from which latitude and longitude are measured.

Latitude. The lines of latitude run due east and west, and are small circles of the sphere drawn parallel to the equator; we may conceive one of these drawn through every place. The portion of a meridian intercepted between a place and the equator is called the latitude, and is denominated north or south as the place is north or south of the equator.


Longitude. The longitude of a place is the portion of the equator intercepted between the prime meridian and the meridian passing over the place; is east or west according as the place is situated east or west of the prime meridian.



As every circle large or small is divided into 360 parts called degrees, it will be seen the equator and poles divide every meridian into four equal parts; therefore the greatest latitude a place can have is 90 degrees, and again the prime meridian divides the parallels of latitude into two equal parts, making 180 degrees the greatest longitude a place can have. Each of these degrees is divided into 60 minutes and the

minutes into 60 seconds. The minutes of the equator and of the meridians are each nearly 6080 feet long, and are called **Nautical or Sea Miles.**

The parallels of latitude being small circles and decreasing in size the nearer they approach the poles, while the meridians come together at the poles, it would be difficult to construct a chart easy to use in practice. However, upon the principles of Mercator a chart is constructed upon which the meridians are represented as being parallel to each other during their whole length, and the distance between the parallels of latitude is increased in the same proportion the nearer they approach the poles. This enables a course from one place to another to be laid down by a straight line between them, and the distance is obtained from the scale to the side of the chart as nearly opposite the two places as possible.

All charts are engraved true north and south, east and west, and in all the charts furnished by the Hydrographic Office the true compass is engraved in various places and the bearings given are the true bearings. Lines of variation are drawn upon the chart or the variation is given marked with each compass on the chart.

A current is marked on the chart by an arrow with two feathers pointing in the direction towards which it sets . And the drift or rate per hour at which it moves is marked in knots close to the arrow.

The set of the tide is marked on the chart by an arrow feathered on one side only for the flood  and by an arrow without feathers for the ebb tide .

The tide is spoken of as *flood* when the water is rising, and as *ebb* when the water is falling; and to show when either occur, the time of high water at the full and change, that is to say at full moon and new moon, is given at the most important places on the chart. The hours are marked in Roman and the minutes in ordinary figures, thus, VII h. 50 m. For any particular spot this time of high water at the full and change may be considered practically constant. Any almanac will give the moon's age; but by a little practice it may be guessed within a day. When the moon looks like a D it is increasing or waxing, and when it looks like a C it is decreasing or waning.

The rise of **Spring Tides** or those which occur near the full and change of the moon, and the rise of the **Neap Tides** or those which occur near the 1st and 3d quarters of the

moon, are given in feet. Sometimes this information about the tides is given in a table on the chart.

Tides are caused chiefly by the moon, and as the moon is about 50 minutes later every 24 hours in coming over the same spot of the earth, the time of high water will be about 50 minutes later every day. In most places the tide rises twice in every 24 hours, which would make a regular interval of 12 hours between the times of successive high water, and 25 minutes additional for the retardation of the moon.

The calculations for finding the exact time of high water are puzzling, and require tables that may not be at hand. It is important to know the time, because in many channels it is only at high water that a vessel can get over the bar. First find the number of days from the last new or full moon, multiply this by 50, the number of minutes that the high tide is delayed each day, and add the product in hours and minutes to the time of high water given on the chart, A.M. or P.M., as the case may be. Or you can reckon forward the number of days to the *next* new or full moon, and then *subtract* the product from the time on the chart. The question whether you will reckon backwards or forwards depends on whether the last new or full moon, or the coming new or full moon, is furthest off. Of course you will reckon to whichever is nearest.

The time of high water obtained in this way may be depended upon within the hour, yet it may be out at times as much as two hours. The greatest error will occur during neap tides, hence by subtracting one hour from the time of high water at neap tide, will diminish this error. The following table will show how the rule works :

| Before the new or full moon. | | Subtract. |
|---|---|-----------|
| For 1 day | . | hrs. min. |
| " 2 " | . | 0 50 |
| " 3 " | . | 1 40 |
| " 4 " | . | 2 30 |
| " 5 " | . | 3 20 |
| " 6 " | . | 4 10 |
| " 7 " | . | 5 00 |
| | . | 5 50* |
| After the new or full moon add the above times. | | |

* At neap tide subtract 1 h. from time of high water.

For example. The high water at full and change at Old Point Comfort is 8.46; at what time will it be high water on the 10th June, 1888?

From any almanac we find that in June the new moon occurs on the 9th in the afternoon, and the full moon on the 23d in the afternoon. Now the 10th of June is one day after the new moon, therefore to the above table we must add 50 minutes to 8.46, which gives 9.36 P.M. as the time of high water on the 10th of June.

Again, what time will it be high water on the 20th of June? Now the 20th of June is three days before the full moon, therefore, from the above table we must subtract 2.30 from 8.46, which gives 6.16 P.M. as the time of high water on the 20th of June.

The soundings marked on the chart are reduced to mean low water, and are generally given on the plain section in fathoms (of six feet) and fractions of a fathom; and on the shaded surface in feet and fractions of a foot.
















Large charts are constructed for each ocean upon a too small scale for practical purposes when near shore, but to facilitate their use they are divided into marked sections accompanied with an index chart. These sectional charts have engraved upon them at the most convenient places, divided from the rest of the chart, a plan of the most important harbors upon a scale large enough for the various marks to be indicated and the nature of the channel understood.


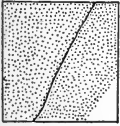
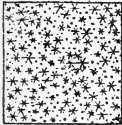
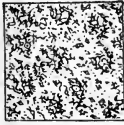










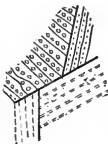











With the chart use is made of a pair of dividers and parallel rulers, the application of which will be shown in working some of the problems.

SIGNS AND ABBREVIATIONS MARKED ON THE CHART.

| Nature of the Bottom. | General Abbreviation. |
|-----------------------|---|
| b. blue | An. anchorage |
| blk. black | Bk. bank |
| br. brown | C. cape |
| brk. broken | Ch. church |
| c. coarse | Chan. channel |
| cl. clay | Cr. creek |
| crl. coral | Fms. fathoms |
| d. dark | Ft. feet or foot |
| f. fine | H. W. high water |
| g. gravel | H. W. F. & C. high water, full and change |
| gn. green | I. island |
| grd. ground | Lat. latitude |
| gy. gray | Long. longitude |
| h. hard | Lt. light |
| m. mud | Lt. F. light fixed |
| oys. oysters | Lt. Fl. light flashing |
| oz. ooze | Lt. Int. light intermittent |
| peb. pebbles | Lt. Rev. light revolving |
| r. rock | Lt. Flg. light floating |
| rot. rotten | Lt. Occ. light occulting |
| s. sand | Lt. Alt. light alternating |
| sft. soft | L. W. low water |
| sh. shells | Mt. mountain |
| spk. speckled | Np. neaps |
| st. stones | Obs. Spot. observation spot |
| stf. stiff | Pk. peak |
| w. white | Pt. point |
| wd. weed | R. river |
| y. yellow | Rf. reef |
| | R. rock |
| | Sh. shoal |
| | Sp. spring |
| | Str. strait |
| | Var. variation |
| | Vis. visible |

CHARACTERISTIC SIGNS MARKED ON THE CHART.

| | | | | |
|--|---|--|---|---|
|  <p>CLIFFY COAST LINE</p> |  <p>SWAMP OR MARSHY LAND</p> |  <p>SAND WITH GRAVEL</p> |  <p>ROCKS WITH DANGER LINE</p> |  <p>WIND MILLS</p> |
|  <p>SHORE, STEEP TO SANDY BEACH</p> |  <p>ROCKY LEDGES</p> |  <p>SAND AND MUD</p> |  <p>SHOAL AND DEPTH GIVEN</p> |  <p>TOWN</p> |
|  <p>SAND HILLS</p> |  <p>ROCKS UNDER WATER</p> |  <p>GRAVEL BANK</p> |  <p>DOUBTFUL ROCKS</p> |  <p>WOODED MARSH</p> |

| | | | | |
|--|--|---|--|---|
|  <p>MANGROVE</p> |  <p>SAND, HIGH AND LOW WATER</p> |  <p>PINE</p> |  <p>OAK</p> |  <p>GRASS</p> |
|   <p>ROCKS AWASH</p> |   <p>STONY BANK DRY AT LOW WATER</p> |  <p>MOORING BUOY</p> |   <p>ROCKS IN SIGHT</p> |   <p>MUD BANK, DRY AT LOW WATER</p> |
|  <p>CULTIVATED GROUND</p> |   <p>SAND, DRY AT LOW WATER</p> |   <p>CORAL REEFS</p> |   <p>ANCHORAGE FOR SMALL VESSELS</p> |  <p>ANCHORAGE FOR LARGE VESSELS</p> |
|  <p>TREES</p> |  <p>SANDY BEACH</p> |  <p>CHURCH</p> |  <p>KELP</p> | |

67 00 00
 39 22 30
 28 7 30

EXAMPLES.

I. The compass course is ESE., or S. $67^{\circ} 30' 00''$ E. The variation and deviation $2\frac{3}{4}$ points E., leeway $\frac{3}{4}$ points right. What is the true course? *Ans.* S. $28^{\circ} 07' 30''$ E. *left*

II. The compass course is SSW., the variation being 1 point easterly. Find the true course. *Ans.* SW. by S.

III. An object bore by compass NE. by E. $\frac{3}{4}$ E., the variation being $1\frac{1}{2}$ westerly. Find its true bearing. *Ans.* NE. $\frac{1}{4}$ E.

IV. Compass course is S. and the wind is NW., giving $\frac{3}{4}$ points leeway, variation 1 point E. and the deviation $\frac{1}{4}$ point W. Find the true course. *Ans.* S.

V. The true course is S. by W.; variation is 2 points W.; deviation is 5° W. Find compass course. *Ans.* S. $38^{\circ} 45'$ W.

VI. The true course is W. by S., and the variation is $11^{\circ} 15'$ E., deviation is 9° W., wind NNE., leeway of 2 points. Find the compass course. *Ans.* N. 81° W.

VII. The compass course is SSE., with variation 2 points W., and deviation 5° E., the wind on the left hand giving 3 points leeway. Find the true course. *Ans.* S. $6^{\circ} 15'$ E.

VIII. The compass course is NE., and variation is 2 points E., deviation 2° E., wind on the right hand giving 3 points leeway. Find the true course. *Ans.* N. $35^{\circ} 45'$ E.

CHAPTER II.

PILOTING OR COASTING.

HAVING become thoroughly familiar with the instruments described, the ship is gotten underway and taken down the harbor or bay for an offing at sea. In doing this the rudest manner of navigation is used, called **Piloting or Coasting**, which requires only a local knowledge of the shore and its adjacent waters, together with the location of marks placed to aid navigation, all of which are given in the charts.

The effect of the tides and local currents along the shore is most treacherous, and may at any time cause the ship to be drifted out of the channel or into a dangerous position to some reef or shoal, to avoid which the actual position is often a matter of vital importance. A frequent cast of lead may give warning, and should be constantly kept going whenever on soundings, and carefully taken. If the ship is becalmed the ground log will indicate the direction and rate of drift.

Cross-bearings. When two known objects are in sight the ship's position is found by cross-bearings. Thus, as the ship proceeds down the channel the starting-point buoy bore per compass ENE., and a lighthouse N. $\frac{3}{4}$ W., while the ship's head was NW. Enter the deviation table, which should always be at hand in a little note-book, with the ship's head NW. in the first column, and the deviation to be applied in the second column is $4^{\circ} 30'$ W. Applying this to the left will give the magnetic bearings; and if the variation was 5° E., apply it to the right, and the true bearings will be:

| | Starting Buoy | Lighthouse. |
|---------------------|------------------------|------------------------|
| By compass..... | N. $67^{\circ} 30'$ E. | N. $8^{\circ} 20'$ W. |
| Deviation W..... | $4^{\circ} 30'$ left | $4^{\circ} 30'$ left |
| Magnetic bearing... | N. $63^{\circ} 00'$ E. | N. $12^{\circ} 50'$ W. |
| Variation E..... | $5^{\circ} 00'$ right | $5^{\circ} 00'$ right |
| True bearing..... | N. $68^{\circ} 00'$ E. | N. $7^{\circ} 50'$ W. |

Apply the parallel ruler to the engraved compass on the chart lying along N. 68° E and the centre of the compass; then work the ruler until the edge touches the start buoy and draw a pencil line along its edge on the chart. Apply in like manner the N. $7^{\circ} 50'$ W. line to the lighthouse. Where these two lines cut each other will be the position of the vessel.

The bearings of these two points should not be too near each other, for then the lines would have a bad intersection; but if the two objects be in line, it is of great advantage, especially so when in the direction the ship is steering, as their separation will indicate a deviation from the channel.

Where the two lines cross, or the position of the ship, it is marked by a little pencil cross with the hour and date thus, $\times \frac{2 \text{ P.M.}}{12/3}$, to identify it, which means the ship was in this position at 2 in the afternoon of March 12.

Bow and Quarter Bearing. A very simple means of finding the constant position of the ship is by what is known as the bow and quarter bearing. Take the bearing of one known object on shore when it is on the bow and measure the distance by log till it bears abeam; then the distance, should there be no current, will be the distance of the object when abeam.

Bearing of One Object. When it is impossible to get a bow and quarter bearing, such as having to change the course, the ship's position can be found by taking the bearing of the point when not in the direction the ship is sailing, and when the bearing has changed at least 3 points take a second bearing. Lay off from the given point the two bearings corrected for variation and deviation, and, after laying the parallel ruler in the direction of the true course, take the distance sailed in the dividers and move the ruler towards the given point till the distance fits exactly between the two lines and draw a pencil line. At the two points of intersection will be the first and second position of the ship.

Whenever the vessel is in the vicinity of land this method should frequently be used as a check to the influence of unknown currents.

By Sailing Directions or Chart. When the channel has long stretches winding between shoals or among islands, the sailing directions or chart gives the true or magnetic courses and bearings. Suppose they are magnetic, such as steer

NE., till a certain object bears N. by W., and then steer E. till another object bears SW. In such a case the magnetic course and bearing are given to find the compass course and bearing of the object. Look in the 3d column of the deviation table for the magnetic course, expressed in degrees and minutes.

If it be not one of the courses it will lie between two of them, and the corresponding compass course will lie between two courses in the 1st column and may be found by estimating. To find the compass bearing look in the 3d column for the magnetic course; opposite to it in the 2d column will be the deviation on that course.

Apply this deviation to the magnetic bearing to the left if the deviation is easterly and to the right if westerly.

EXAMPLE.

Suppose the chart should give directions to steer E. till a certain object bore N. by W., then steer SE. till another object bore SSW. magnetic.

In column 3, when the course was E., the deviation was between $6^{\circ} 40'$ E. and $7^{\circ} 30'$ E., or nearly $\frac{1}{2}$ point E. Applying this to the left of the first course, the vessel should steer E. $\frac{1}{2}$ N. by the compass till the first object bore by compass N. by W. $\frac{1}{2}$ W. So from column 3 with the course SE. the deviation is between $2^{\circ} 00'$ E. and $3^{\circ} 40'$ E., or nearly $\frac{1}{4}$ point E. Applying this to the left of the second course, the vessel should steer SE. $\frac{1}{4}$ E. till the second object bore by compass S. by W. $\frac{3}{4}$ W.

In going around a point and no channel marked out, select several spots on the chart, the connection of which will permit the line joining them to pass over safe soundings. With the points of the dividers on two of the spots, transfer them to the scale and measure the distance; then with the edge of the parallel ruler along the line, move it to the nearest compass, and the point over which the edge comes will be the true course; correct this for variation and deviation to get the compass course. Put the ship's head on that course and sail the distance, when the same process will be repeated.

Should the ship be shut in by a fog or snow storm for a time out of sight of land, the channel and nature of the

bottom, as well as soundings by the hand or deep-sea lead, will give a close approximation to the position of the ship.

When the latitude and longitude are known, the position of the ship is plotted on the chart by laying the parallel ruler even with the nearest parallel of latitude marked on the side of the chart, and after moving it up to the given latitude draw a pencil line, which will represent the latitude of the ship; then measure with the dividers at the top and bottom of the chart the distance from the nearest meridian to the given longitude, which, set off on the parallel previously drawn with pencil, will be the ship's position.

To Verify the Deviation Table. When the vessel was swung in the harbor for deviation there might have been some local attraction unknown which would of course affect the local deviation table. To ascertain this, it is an excellent opportunity, as the vessel proceeds along the various courses in the channel, to verify the deviation table by frequent bearings of known objects on shore, or when two objects come in line. The chart will give their true bearings, and when converted to the compass bearings by the application of variation and deviation there should be no difference between this bearing and the compass; if so, the deviation is wrong and must be corrected before going to sea.

CHAPTER III.

DEAD-RECKONING.

Shaping the Course. The vessel having now arrived at the point where it becomes necessary to commence her voyage at sea, the bearing and distance to the point it is intended to take the vessel are found from the chart by laying the ruler with the edge along the two places, then transfer the ruler to the nearest compass on the chart, which will give the true bearing. Correct the true bearing for variation and deviation to the left if easterly, and to the right if westerly, for the compass course, and the ship is kept as near that course as the wind and other circumstances will admit.

With the dividers, measure the distance on the scale to the side of the chart as nearly opposite the two places as it is possible.

If islands, capes, and headlands intervene, it will be necessary to find several courses and distances in the same way. This is called *Shaping the Course*.

Taking the Departure. When just about to leave the land take the bearing of some known object, such as a lighthouse or headland, by the compass and estimate the distance by eye, or the bearing and distance of the object from the ship. This may be found by one of the processes already described. This is called *Taking the Departure*.

Log-slate. The opposite point to that on which the object bears is considered the first course, and the distance of the object as the first distance sailed from the place and is noted on the log-slate. This *Log-slate* is a memorandum board or book properly ruled for the hours of the day, distance made by the log, courses steered by the compass and the direction of the wind, leeway, variation, and deviation, as well as remarks of all causes affecting the sailing of the ship.

Log-book. The other courses and distances made during the day being determined by the compass and the log are severally entered in the log-slate at the end of each hour, and afterwards copied into a book similarly ruled, called the *Log-book*.

It must be borne in mind that the standard compass is the compass from which all courses for the log-slate are taken. In steering, the course is taken from the standard compass and the man at the wheel given his course for the steering compass by a careful comparison. As the vessel proceeds on her course frequent comparisons should be made between these two compasses.

In a violent gale and heavy sea, when it would be dangerous to carry sail, it is usual to put the ship close to the wind with just sufficient sail to prevent the vessel from rolling too much. In this condition the vessel will come up and fall off, and the points to which her head comes up and falls off must be noted, and the middle point between the two taken as the course to enter in the log-slate.

If there should be a set and drift of a current it is to be entered as a course and distance, and treated the same as any course and distance.

Dead-reckoning. The process by which the position of the ship is found from the data given in the log-book is called *Dead-reckoning*. By means of this dead-reckoning the latitude and longitude are found, hence the position of the ship. It is usual to obtain the position at 8 A.M., 12 M., and 8 P.M. of each day, and more frequently when approaching land or danger.

The process by which this is accomplished is, first, correct the several courses in the log-book for the variation, deviation, and leeway opposite to each course. Construct a table in the *Work-book*, in which all data in navigation should be preserved during the entire voyage. In the first column of this table enter each true course, and in the second column the distance run on each course, found by summing up the knots and tenths sailed by the ship on each course.

Find in Table I the courses at the top or bottom of the page given in degrees, the *difference of latitude* and the *departure* corresponding to each course and distance, and place them in their respective columns; then the difference between the sums of the *northings* and *southings* will be the *difference of latitude made good* of the same name as the greater.

Seek in the same table until the difference of latitude and departure are found together in their respective columns; opposite to these in the distance column will be the *distance made good*.

At the top or bottom of the page, according as the departure is less or greater than the difference of latitude, will be found the *course made good*.

If the latitude of the object from which the departure was taken or the latitude of a former position be of the same name as the difference of latitude found, add them together; but if of different names take their difference; the sum or remainder will be the *latitude in* of the same name as the greater.

As departure is the lineal distance between two meridians measured upon a parallel of latitude, it is less than the difference of longitude, which is measured upon the equator; so to find the difference of longitude take the middle latitude between the two places which take as a course in Table I., and seek for the departure in the difference of latitude column; then will the corresponding distance be the *difference of longitude* of the same name as the departure. If the longitude of the previous

position be of the same name as the difference of longitude add them together, but if of different names take their difference; the sum or difference will be the *longitude in* of the same name as the greater.

The intersection of the latitude and longitude found on the chart will be the position of the ship, from which the bearing and distance of the port or other object can again be found. It is especially important to always find the bearing and distance of any supposed or real danger whenever the position of the ship is plotted

EXAMPLE.

When the ship was about to leave the land on July 15th, the departure was taken from Cape Henry light-house, which bore per compass NNW., distance 20 miles; afterwards sailed by the following log account:

LOG-BOOK OR SLATE-TABLE.

| Hours. | Knots. | Tenths. | Courses. | Wind. | Leeway. | Var. | Dev. | True Courses. | Remarks. |
|--------|--------|---------|------------------|------------|---------|------|---------|---------------|---|
| noon | 20 | 0 | SSE. | Departure. | | 10° | 0 30 W. | S. 33 00 E. | A current set the ship during the last 2 hours 1-2 m. an hour SW. as shown in chart. Mod. breeze, smooth sea on, sail, etc. |
| 1 | 6 | 5 | SE. by E. | NE. | 1 pt. | „ | 3 40 E. | S. 51 20 E. | |
| 2 | 5 | 0 | „ | „ | „ | „ | „ | S. 51 20 E. | |
| 3 | 6 | 0 | SE. | ENE. | 2 pt. | „ | 2 00 E. | S. 30 30 E. | |
| 4 | 5 | 5 | ESE. | S. | „ | „ | 4 30 E. | S. 28 00 E. | |
| 5 | 5 | 0 | E. by N. | SSE. | „ | „ | 7 30 E. | N. 53 45 E. | |
| 6 | 5 | 0 | „ | „ | „ | „ | „ | N. 53 45 E. | |
| 7 | 5 | 0 | „ | „ | „ | „ | „ | N. 53 45 E. | |
| 8 P.M. | 5 | 0 | NE. | SE. | 1 pt. | „ | 8 00 E. | N. 31 45 E. | |
| | 3 | 0 | Current true SW. | | | | | S. 45 00 W. | |

In this case the opposite point to the bearing of the light-house NNW. is SSE., which enter as the first course and the distance 20 miles as the first distance. The variation supposed to be found on the chart was 10° W., and from the deviation table for the course SSE. we find 00° 30' W., which, applied to the left as they are both westerly, gives the true course S. 33° 00' E.

Again, for the second course at 1 P.M. the log indicated the ship as making 5 miles the first hour and the compass course SE. by E. with the wind NE. or on the port tack, the left side; hence the leeway of one point is to the right. The variation

of 10 degrees is west or left, and the deviation from the table 3° 40' is east or right; hence the true course is S. 51° 20' E. in the last column, and so on with the other courses.

The drift of the current being one and a half miles per hour for the last two hours drove the ship 3 miles in the direction of the set SW. true, which enter as though the ship had sailed that the last course and distance.

Having now obtained the true courses sailed, enter them in the table of the working-book with the sum of the distances made on each course:

WORK-TABLE.

| Courses. | Distances. | DIFF. LATITUDE. | | DEPARTURE. | |
|-------------|------------|-----------------|------|------------|------------|
| | | N. | S. | E. | W. |
| ° / | | | | | |
| S. 33 00 E. | 20.0 | | 16.8 | 10.9 | |
| S. 51 20 E. | 11.5 | | 7.2 | 8.9 | |
| S. 30 30 E. | 6.0 | | 5.2 | 3.0 | |
| S. 28 00 E. | 5.5 | | 4.8 | 2.5 | |
| N. 53 45 E. | 15.0 | 8.8 | | 12.1 | |
| N. 31 45 E. | 5.0 | 4.2 | | 2.6 | |
| S. 45 00 W. | 3.0 | | 2.1 | | 2.1 |
| | | 13.0 | 36.1 | 40.0 | 2.1 |
| | | | 13.0 | 2.1 | |
| | | Diff. Lat. 23.1 | | 37.9 | Departure. |

Course made good S. 58° E. and distance made good 44 miles.

Lat. Cape Henry Light 36° 55' 05" N. Long. 76° 00' 02" W.
 Difference of latitude 23' 06" S. Diff. Long. 47' 00" E.

Latitude in . . . 36° 31' 59" N. Long. in 75° 13' 02" W.

Sum of latitudes . . 73° 27' 04"

Middle latitude . . 36° 43' 30" or 36½'.

The first course, 33°, is found at the top of the page of Table I, and opposite to the distance of 20 the Lat. column gives 16.8 and the Dep. column gives 10.9, which place in their appropriate column in the work-table; the difference latitude under S. and the departure under E. as the ship has sailed south and

east. Do the same way with each course to the nearest degree is sufficient.

After adding up the different columns it will be seen there were more southings than northings, and their difference will give 23.1 S. as the difference of latitude made good. There are more eastings than westings, and their difference will give 37.9 E., the departure made good.

In Table I the place where these come nearest in their respective columns is opposite 44 in the distance column, which is the distance made good.

The departure being greater than the difference of latitude, the course made good is found at the bottom of the page, S. 58° E.

The latitude of Cape Henry being north and the difference of latitude made good being south we take their difference and get the latitude in 36° 31' 59" N., the name of the greater.

With the middle latitude $36\frac{3}{4}$ as a course in Table I, the departure made good is found in the Lat. column opposite the distance 47, which is the difference of longitude of the same name as the departure, which is east, and as the longitude of Cape Henry is west we take their difference to find the longitude in 75° 13' 02" W., the name of the greater.

From this new position of the ship the bearing and distance of the designated place are again found, and the new course followed as nearly as possible.

From 8 P.M., the time of the last position, the ship sailed on a course by compass ESE., with the wind free, 100 miles per log until 8 A.M. the following morning; the chart showing 2 points easterly variation and a constant drift of 2 miles per hour in a true SW. direction. Find the position again. In this case there would not be any leeway.

LOG-TABLE.

| Hours. | Knots. | Courses. | Wind. | Lee. | Var. | Dev. | True courses. |
|--------|-----------|----------------|----------------|-----------|------------------------|-----------|-----------------------------|
| 12 | 100 24 | ESE. Set of | NW. the cur | 0 rent | 2 pts. E. SW. true. | 4° 30' E. | SE. $\frac{1}{2}$ S. SW. |

The variation 2 points being easterly and the deviation from the table 4° 30' E. or nearly $\frac{1}{2}$ point easterly, both are applied to the right to get the true course.

WORK-TABLE.

| Courses. | Distance. | DIFF. LATITUDE. | | DEPARTURE. | |
|----------------|-----------|-----------------|------|------------|------------|
| | | N. | S. | E. | W. |
| ° ' " | | | | | |
| S. 39 22 30 E. | 100 | | 77.8 | 63.4 | |
| S. 45 00 00 W. | 24 | | 17.0 | | 17.0 |
| | | | 94.3 | 63.4 | 17.0 |
| | | | | 17.0 | |
| | | Diff. Lat. | 94.3 | 46 4 | Departure. |

Course made good S. 26° E., and 105 miles the distance made good.

In this case, the nearest the difference of latitude and departure came together in their appropriate columns in Table I. was opposite to 105, the distance made good. As the departure was less than the difference of latitude the course S. 26° E. or SSE. $\frac{1}{4}$ E. was found on top of the page as the course made good.

Latitude of last position 36° 31' 59" N.

Difference of Latitude . 1° 34' 18" S.

Latitude in 34° 57' 41" N.

Sum of the Latitudes . 71° 29' 40".

Middle Latitude . . . 35° 44' 50" or 35 $\frac{1}{2}$ ".

With this middle, latitude 35 $\frac{1}{2}$, enter Table I, and find departure in the Lat. column, and opposite to it in the distance column is 57 miles, the difference of longitude of the same name as the departure, which is east.

Longitude of the last position 75° 13' 02" W.

Difference of longitude . . 57" E.

Longitude in 74° 16' 02" W.

At noon of that day the ship was found by the log to have sailed 30 miles NE. by E. close to the wind on the starboard tack or right hand, making two points leeway. Variation by the chart 7° 30' W.

From the deviation table the deviation on a NE. by E. course is 8° 10' E. The leeway will be to the left.

Compass course NE. by E. is N. $56^{\circ} 15' 00''$ E.Deviation E. $8' 10''$ to the right.Magnetic course N. $64^{\circ} 15' 00''$ E.Variation W. $7' 30''$ to the left.True course N. $56^{\circ} 45' 00''$ E.Or nearly N. 57° E.

WORK-TABLE.

| Courses. | Distance. | DIFF. LATITUDE. | | DEPARTURE. | |
|--------------------|-----------|-----------------|------------|------------|------------|
| | | N. | S. | E. | W. |
| N. 57° E. | 30 | 16.3 | | 25.2 | |
| | | 16.3 | | 25.2 | |
| | | 16.3 | Diff. Lat. | 25.2 | Departure. |

Course made good N. 57° E., and 30 miles the distance made good.

Lat. left $34^{\circ} 57' 41''$ N.Diff. Lat. $16' 18''$ Lat. in $35^{\circ} 13' 59''$ N.Sum of Lats. $70^{\circ} 11' 40''$ Mid. Lat. $35^{\circ} 05' 50''$

With the middle latitude 35 and the departure 25.2 in the Lat. column, the difference of longitude is found to be:

Diff. longitude $31' 00''$ E.Longitude left $74^{\circ} 16' 02''$ W.Longitude in $73^{\circ} 45' 02''$ W.

From this position the ship sailed from day to day on the following courses and distances, taken from the log-book and stated in the following table:

LOG-BOOK.

| Courses. | Distances. | Wind. | Leeway in Points. | Var. | Dev. | True courses. |
|----------|------------|----------------------------|-------------------|---------------------|--------------------|-----------------------------|
| ENE. | 30 | N. | $1\frac{1}{4}$ | $15^{\circ} 20'$ W. | $7^{\circ} 20'$ E. | N. $73^{\circ} 33' 45''$ E. |
| E. by N. | 40 | NNE. | $2\frac{1}{4}$ | $10^{\circ} 10'$ W. | $7^{\circ} 30'$ E. | S. $81^{\circ} 35' 00''$ E. |
| E. by S. | 80 | " | $13\frac{1}{4}$ | $5^{\circ} 00'$ E. | $5^{\circ} 50'$ E. | S. $48^{\circ} 14' 00''$ E. |
| E. | 60 | " | $2\frac{1}{4}$ | $7^{\circ} 00'$ E. | $6^{\circ} 40'$ E. | S. $53^{\circ} 50' 00''$ E. |
| SE. | 30 | Drift..... | | $7^{\circ} 00'$ E. | $2^{\circ} 00'$ E. | S. $36^{\circ} 00' 00''$ E. |
| ENE. | 50 | Current, true course | | | | N. $67^{\circ} 30' 00''$ E. |

REMARKS.—The ship drifted during the time in a gale by wind and sea 30 miles SE. by compass. By current marked in chart ENE. 50 miles.

In the second course it will be seen that after variation and deviation and leeway are applied, the course is greater than 90 degrees, or we have gone through E. from the north and have come nearer S. than N.; therefore we subtract from 180 degrees, which gives the true course S. 81° 35' E. from the South.

WORK-TABLE.

| Courses. | Distances. | DIFF. LATITUDE. | | DEPARTURE. | |
|-------------|------------|-----------------|-------|------------|------------|
| | | N. | S. | E. | W. |
| N. 73 34 E. | 30 | 8.6 | | 28.7 | |
| S. 81 35 E. | 40 | | 6.0 | 39.5 | |
| S. 48 14 E. | 80 | | 53.3 | 59.7 | |
| S. 53 50 E. | 60 | | 35.3 | 48.5 | |
| S. 36 00 E. | 30 | | 24.3 | 17.6 | |
| N. 67 30 E. | | 19.1 | | 46.2 | |
| | | 27.7 | 118.9 | 240.2 | |
| | | | 27.7 | | |
| | | Diff. Lat. | 91.2 | 240.2 | Departure. |

Course made good S. 69° E. and 257 miles made good.

With the first course enter Table I with the course 73. On page with 73 at the bottom and opposite to 30 in the distance column will be found in the Lat. column 8.8, and on page with 74 at the bottom and opposite to 30 in the distance column will be found in the Lat. column 8.3, making a difference of .5 for one degree in the course: hence for half a degree it will be one half of .5, or .2, to be subtracted from 8.8 in the first case, which will give 8.6 for the difference of latitude for the first course, which place in the column N. as northings. As there is so little difference between the departure for 73 and 74, that for either course may be used as the departure in its appropriate column under E., and so on in each course.

Lat. left 35° 13' 59" N.

Diff. Lat. 1° 11' 12" S.

Lat. in 34° 02' 42" N.

Sum of Lats. 69° 16' 46"

Mid. Lat. 34° 38' 23"

With middle latitude 34½ and the departure 240.2 in the Lat. column, the difference of longitude is found to be 291.5 in the distance column; divide by 60 and we get:

Diff. longitude 4° 51' 30" E.

Longitude left 73° 45' 02" W.

Longitude in . 68° 53' 32" W.

Continue in this way until the port is reached.

If it is not convenient to find the course and distance on the chart with the parallel rulers and dividers, it may be done in the following manner. Suppose, for instance, it is desired to know the compass bearing and distance from the last position back to Cape Henry.

Lat. of Cape Henry $36^{\circ} 55' 05''$ N.

Lat. of last position $34^{\circ} 02' 47''$ N.

Diff. Latitude $2^{\circ} 52' 18''$

60

120

52

172.3

Long. of Cape Henry $76^{\circ} 00' 02''$ W.

Long. last place $68^{\circ} 53' 32''$ W.

Diff. Longitude $7^{\circ} 06' 30''$

60

426.5

Sum of Latitudes $70^{\circ} 57' 52''$

Middle Latitude $35^{\circ} 28' 56''$ or $35\frac{1}{2}$

The difference of longitude is too great for the distance column in the table, so divide it by 2 for convenience, and with the half of the longitude, 213.2, enter Table I, and opposite to it in the distance column for 35 and 36 will be found 174.5 and 172.3 in the latitude column; the middle latitude being nearly $35\frac{1}{2}$, take the mean of these, 173.4, for the departure, which multiplied by 2 gives 346.8 for the whole departure. The whole departure and difference of latitude are too large for the table, so divide by any convenient number, say 10, which gives 17.2 diff. latitude and 34.7 departure; with these seek in Table I till they nearly agree on a course S. 63° W. and a distance of 39. Multiply this distance by 10, and we get 390 miles as the whole distance.

Hence Cape Henry bears true S. 63° W., distance 390 miles; and to get the compass bearing or course, variation and deviation must be applied. Let variation be $16^{\circ} 20'$ W.

True course S. $63^{\circ} 00'$ W.

Variation W. $16^{\circ} 20'$ apply to the right.

Magnetic course S. $79^{\circ} 20'$ W.

Deviation W. $8^{\circ} 00'$ to the nearest point to the right.

Compass course S. $87^{\circ} 20'$ W.

Or the ship will have to steer S. $87^{\circ} 20'$ W. 390 miles to return to Cape Henry.

Ship's Track. It is customary, whenever the position of the ship is plotted, to draw a line on the chart from that position to the former one, and the lines so drawn from day to day will be the ship's track—a distinction from the *traverse* which the ship makes in her zigzag course sailing from one position to another against a head wind.

EXAMPLES.

I. Required the compass course and distance from latitude $51^{\circ} 25'$ N. and longitude $9^{\circ} 29'$ W., to latitude $49^{\circ} 16'$ N. and longitude $9^{\circ} 29'$ W. The variation is $19^{\circ} 20'$ W. and deviation is $3^{\circ} 16'$ E.

Ans. Compass course S. $16^{\circ} 04'$ W. Distance 129 miles.

II. A ship sails from latitude $44^{\circ} 30'$ N. 290 miles, when she finds her departure is 161.1. What is the true course she has sailed, the difference of latitude, and latitude in (to N. and W.)?

Ans. Course NW. by N. Diff. latitude 241.1 and Latitude in $48^{\circ} 31' 06''$ N.

III. What is the position of the ship after sailing on the following courses (true) and distances: NNE. 40 miles; E. by S. 60 miles; SE. 70 miles; and SW. 48 miles?

Ans. Diff. lat. 58.2; dep. 89.7; course made good S. $57^{\circ} 01'$ E.; distance 106.9.

IV. A rock was sighted in latitude $39^{\circ} 40'$ S., longitude $87^{\circ} 15'$ E., bearing NNE., distant 15 miles. Afterwards sailed: E. by S., 37 miles; ENE., 44 miles; N. $\frac{1}{4}$ W., 51 miles; and ESE., 29 miles. What is the position of the ship? (The bearings and courses are true.)

Ans. Course made good N. 70° E.; distance 103 miles. Latitude in $39^{\circ} 05'$ S.; longitude in $89^{\circ} 17'$ E.

V. From latitude $18^{\circ} 35'$ S., longitude $123^{\circ} 23'$ E., the ship sails 225 miles SW. $\frac{1}{4}$ W. by compass. What is her position? The variation is $1\frac{1}{2}$ point E. and deviation is $6^{\circ} 35'$ W.

Ans. Latitude in $20^{\circ} 24' 06''$ S.; longitude in $119^{\circ} 55' 00''$ E.

VI. A danger bears by compass S. 34 E. 29 miles, variation is one point west, and deviation is $1^{\circ} 50'$ E. What is the true bearing of the danger? The latitude of the danger is $00^{\circ} 52'$ N. and longitude is $2^{\circ} 40'$ E.

Ans. N. $43^{\circ} 25'$ W., 29 miles.

CHAPTER IV.

BY OBSERVATIONS.

THE method of finding the ship's position by dead-reckoning must of course be liable to many errors, arising from the great difficulty in steering a steady course, different rates of sailing between the times of heaving the log, incorrect allowance for leeway and variation, and more frequently from the effects of the drift of the sea and unknown currents; hence it becomes necessary to determine the position by celestial observations when the opportunity offers.

The Zenith. The heavens appear to form the upper half of a hollow sphere, and this celestial surface may be conceived to be divided by imaginary circles that are made to correspond with those of the earth; thus if the axis of the earth were extended it would pass through the north and south poles of the heavens. The celestial equator is a circle in the heavens corresponding with the equator of the earth, and the celestial meridians correspond also with those of the earth; hence it will be seen that if we determine the point immediately over head, called *The Zenith*, it would be the same as finding the position of the ship on the earth. The method for finding this position differs from that of dead-reckoning in the determination of the position directly from observations of the heavenly bodies and not by a reference to some other geographical spot.

The instruments used to obtain the data necessary for the determination of the position by observations are the **Chronometer** and **Sextant**.

The Chronometer is a superior kind of watch, so constructed that its daily gain or loss by variation of temperature

is reduced to a minimum. The machinery is of such delicate construction that the greatest possible care must be taken of it both at sea and in harbor. It should never be moved from its place on board, but kept as near the same temperature as possible, and is defended from violent shocks by the case being lined with soft wool and preserved in a horizontal position by being hung on gimbals. It should be wound up every day at the same hour and the key turned steadily through each turn.

Error and Rate. The chronometers are intended to keep the mean time of Greenwich, but as none of these are perfect the *Error* should be ascertained before going to sea and also its *Daily Rate*.

The error is said to be *fast* or *slow* as the chronometer is fast or slow of Greenwich mean time. The daily rate is the change in its error in twenty-four hours, and if the instrument is going too fast the rate is said to be *gaining*: if too slow, *losing*.

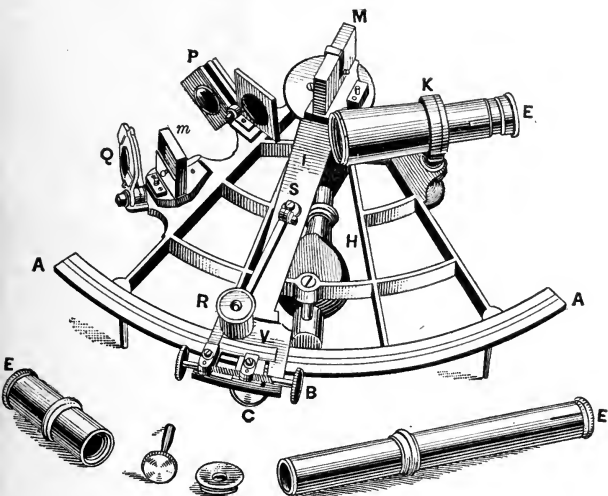
A chronometer is best rated at an observatory; but at all large sea-ports an electrical ball is dropped at a certain hour every day from a point at which it can be seen from all over the harbor. By a comparison with this the error can be found, and if taken in successive days the rate. In the absence of this some good clock-maker can be found to compare your chronometer with one of known rate and error.

After going to sea the rate is almost sure to change some; and it is not unwise, on arriving in port, to compare with the chronometers of other ships, should there be no time-ball. The difference between the two rates being divided by the interval elapsed will be what is called the *sea rate*.

The Sextant is an instrument used to measure the altitude of a heavenly body above the horizon, or the angular distance between objects. The description, names, and uses of the different parts may be best learned from the instrument itself, which may be found in almost any optician's store.

From the figure the names of the different parts may be seen. *AA* is the limb; *I*, the index-bar; *M*, the index-glass, which stands upon and moves with the index-bar; *m* is the horizon-glass fixed to the frame, and which is only silvered on half the surface; *P* and *Q* are the shade-glasses to modify the brightness of the sun; *E* is the sight-tube or telescope carried by the collar *K*; *R* is the magnifying-glass to assist in reading the

scale, is attached to an arm which moves upon a pivot S ; B is the tangent-screw to give a small motion to the index-bar



THE SEXTANT.

when the clamp-screw is tight. C is the clamping-screw, and V is the vernier carried by the index-bar.

The limb is graduated to 120° from the zero point and to a few degrees on the opposite side of the zero point. The degrees are divided at every ten or twenty minutes, and these are subdivided by the vernier to ten or twenty seconds, thus enabling the angles to be read by estimating to five or ten seconds.

The Adjustments are four in number. I. See if the index-glass is perpendicular to the plane of the instrument by placing the index near the middle of the limb, and whilst looking in the index-glass see if the reflected limb in the glass forms an unbroken line with the limb itself ; if not, make it so by means of the screws at the back of the glass.

II. See if the horizon-glass is perpendicular to the plane of the instrument, by looking through the sight-tube and the horizon-glass at the horizon and holding the instrument in a

vertical position, move the index till the reflection of the horizon in the silvered part of the glass forms an unbroken line with the one seen direct, fasten the index by the clamp-screw and incline the instrument to the right or left to see whether the true and reflected horizons continue to form an unbroken line; if not, they can be made so by means of the screw at the back of the instrument.

III. See that the axis of the telescope, when screwed into the collar, is parallel to the plane of the instrument by placing two of the wires of the telescope parallel to the plane of the instrument, and then measure the distance between two objects more than 90° apart, and bring them in contact on the wire nearest the instrument; by moving the sextant slightly the two objects may be brought to the other wire; if they still be in contact the adjustment is correct, but if they separate or top one over the other, the adjustment is made by means of the screws in the collar of the telescope.

IV. See that the horizon-glass is parallel to the index-glass when the zero of the vernier is opposite to zero on the limb by looking at the horizon and holding the instrument in a vertical position. Place the two zeros together and look through the horizon glass at the horizon, holding the instrument vertical. If the true horizon through the clear part of the glass appear in a straight line with the reflected in the silvered part the two glasses are parallel; if not they are made so by turning the lower screw at the back of the glass.

Index Error. If this last adjustment has not been correctly made the instrument can be used as well, but the reading will want correction for every angle measured; this correction is called the *Index Error*. This error is found by making the horizons form an unbroken line whilst holding the instrument in a vertical position, and the distance from zero on the limb to the zero on the vernier will be the index error, to be subtracted from the angles measured if zero on the vernier is to the left of zero on the limb, otherwise add. A more accurate way is by measuring the diameter of the sun on both sides of zero. If both measurements read alike there will be no index error; if they are unlike, half their difference will be the index error, to be subtracted if the measurement taken on the left of zero is larger; otherwise, to be added.

To Take an Altitude. When taking an altitude of the sun

it is customary to bring the sun's lower limb in contact with the horizon, but if the lower limb is obscured the upper limb can be used. As no level or plumb-line can be used in taking the altitude the sextant should be held as nearly perpendicular as possible, and when the reflected image is brought down to the horizon by moving the index by hand clamp it there, and while sweeping the horizon the image will appear to form a curve; use the tangent-screw till the limb just touches the horizon at the lowest part of the curve.

The altitude when thus taken on the meridian enables us to find the latitude, and when not taken on the meridian furnishes the means of finding the time of the ship and thence the longitude. This altitude above the sea horizon is called the *Apparent Altitude* and must be corrected to reduce it to the *True Altitude*. These corrections are: *dip*, *index error*, *refraction*, *parallax*, and *semi-diameter*.

The Dip is the depression of the sea horizon below the level of the eye, and will depend upon the elevation of the eye above the level of the sea; should be subtracted from the apparent altitude because it makes the altitude appear more than it really is. The dip is given in Table II.

Refraction is due to the earth's atmosphere, which bends the rays of light passing through it into a position more nearly vertical and thus enabling us to see a heavenly body when really below the horizon. The effect then of refraction is to make the heavenly body appear higher than it really is; hence the correction for refraction must be subtracted from the apparent altitude. This correction depends upon the altitude of the heavenly body being most when near the horizon and nothing when in the zenith. The refraction is given in Table II.

Parallax is a correction to be added to the apparent altitude to make it what it would have been if observed at the centre of the earth. The parallax decreases with the altitude, being most when in the horizon and nothing when in the zenith. Parallax is given in Table II.

Semi-diameter is the correction to be applied to obtain the altitude of the centre of the object. If the lower limb of the sun was used it should be added to the apparent altitude and subtracted when the upper limb is used. *The semi-diameter of the sun may be taken at 16'.*

CHAPTER V.

TO FIND THE LATITUDE.

Astronomical Date. In finding certain data from the tables the astronomical date is used, which begins 12 hours behind the *civil date*, and is counted from noon to noon, or 24 hours, whereas the civil date commences at midnight and is divided into two parts of 12 hours. Suppose the day is what is ordinarily called the 4th July, and it wants 2 hours to noon, it would be 10 A. M. of the 4th July civil date, but astronomically it is July 3d, 22 hours.

To Find the Latitude. The latitude of a place, being its distance from the equator measured on the meridian, must correspond with the distance from the celestial equator to the zenith. As the zenith is right overhead, it is 90 degrees from the horizon; hence, if the celestial equator were visible in the heavens, it would only be necessary to take its altitude, which subtracted from 90 would give the latitude. As we cannot see the equator, some heavenly body is taken whose distance from the equator is known. In case of the sun, it appears to move during the year in a path inclined to the equator at an angle of 23 degrees and 28 minutes, crossing the equator twice during the year, once in March and again in September, reaching its farthest north in June and farthest south in December. Its distance at any time from the equator measured on a meridian is called its **Declination**, *north when it is north of the equator, and south when south of it.*

The declination is given in Table III for each month when the sun is on the meridian of Greenwich; and as the declination is constantly changing, the difference for one hour is also given in the table.

To find the declination at any time, obtain the astronomical date, and take from Table III the declination opposite the day of the month; now multiply the difference for one hour by the longitude in time, which is one hour for every 15 degrees, and, if the declination be increasing, add in west but subtract in east longitude. If the declination be decreasing, subtract in west but add in east longitude.

The **Meridian Altitude** of the sun is the greatest it will acquire during the day, and as it crosses the meridian it is necessary to commence taking its altitude a little before, and keep its image in contact with the horizon till it begins to fall. Correct this altitude to find the true altitude according to the principles previously explained, and to avoid any mistakes it would be best to prefix the signs of addition and subtraction, $+$ and $-$, to the known corrections and those that are found in Table II. These corrections may be written in a separate form, and applied one to the other according to their several signs for a whole correction to be added or subtracted as the sign implies.

Meridian Zenith Distance. As the zenith is 90 degrees from the horizon, subtracting this true meridian altitude from 90 will give the distance of the sun from the zenith while on the meridian, or the *meridian zenith distance*. *This meridian distance mark north when the sun bears south, or south when it bears north.*

Now with the meridian zenith distance given and the declination known, the latitude is found by adding them together if they are of the same name, or taking their difference if of different names. The latitude will be of the same name as the greater.

EXAMPLES.

At sea, June 21, 1887, in longitude 60° W., the observed altitude of the sun's lower limb was $40^{\circ} 04'$; sun bearing south; index correction $3' 00''$ (add); height of the eye 20 feet. Find the latitude.

In Table III, with the year at the top and the day of the month at the left of the page, we find the declination under June to be $23^{\circ} 27' \text{ N.}$, and the corresponding difference for one hour to be zero. This difference for one hour multiplied by four hours, the longitude (60 divided by 15), gives for the correction to the declination nothing; hence the true declination is $23^{\circ} 27' 00'' \text{ N.}$

The observed altitude, $40^{\circ} 04'$, having been corrected as before explained, the true altitude is found to be $40^{\circ} 17' 35''$, which subtracted from 90 gives the meridian zenith distance $49^{\circ} 42' 25''$, which is marked north as the sun bore south.

The declination and meridian zenith distance having the

same name, we take their sum and find the latitude to be $73^{\circ} 09' 25''$ N.

For the sake of convenience it is always best to have a particular form for all problems in which the data are written and the result obtained; besides it tends to preserve neatness in the navigation book, and facilitates an easy means of comparison with other results.

The form in this case should be:

| | |
|---------------------------------|-------------------|
| Obs. Alt. $40^{\circ} 04' 00''$ | S. D. $+16' 00''$ |
| Corr. $+13\ 35$ | I. C. $+3\ 00$ |
| <hr/> | Ref. $-1\ 09$ |
| True Alt. $40\ 17\ 35$ | Dip $-4\ 23$ |
| $90\ 00\ 00$ | Par. $+07$ |
| <hr/> | <hr/> |
| M. Z. D. $49\ 42\ 25$ N. | Cor. $+13\ 35$ |
| True Dec. $23\ 27\ 00$ N. | |
| <hr/> | |
| Latitude $73\ 09\ 25$ N. | |
| Dec. $23^{\circ} 27' 00''$ N. | Hr. Diff. $0''$ |
| Corr. $00\ 00$ | Long. 4 hrs. |
| <hr/> | <hr/> |
| True Dec. $23\ 27\ 00$ N. | Corr. 0 |

At sea June 1, 1886, in longitude $48^{\circ} 40'$ W., the observed altitude of the sun's lower limb was $72^{\circ} 14' 10''$; sun bearing south; index error $+3' 45''$; height of the eye 22 feet. Find the latitude.

Longitude $48^{\circ} 40'$ W. is 3 hrs. 14 m. 40 s. W., or $3\frac{1}{4}$ hrs. nearly.

| | |
|---------------------------------|-----------------------------|
| Obs. Alt. $72^{\circ} 14' 10''$ | S. D. $+16' 00''$ |
| Corr. $+14\ 54$ | I. C. $+3\ 45$ |
| <hr/> | Ref. $-0\ 18$ |
| True Alt. $72\ 29\ 04$ | Dip $-4\ 36$ |
| $90\ 00\ 00$ | Par. $+3$ |
| <hr/> | <hr/> |
| M. Z. D. $17\ 30\ 56$ N. | Corr. $+14\ 54$ |
| True Dec. $22\ 06\ 05$ N. | |
| <hr/> | |
| Latitude $39\ 37\ 01$ N. | |
| Dec. $22^{\circ} 05' 00''$ N. | Hr. Diff. $20''$ |
| Corr. $+1\ 05$ | Long. $3\frac{1}{4}$ hrs |
| <hr/> | <hr/> |
| True Dec. $22\ 06\ 05$ N. | Corr. $+65''$ or $+1' 05''$ |

At sea June 25, 1886, in longitude $59^{\circ} 15' \text{ E.}$ (3 h. 57 min.), the observed altitude of the sun's upper limb was $60^{\circ} 23' 14''$; sun bearing north; index error $- 2' 21''$; height of the eye 30 feet. Find the latitude.

| | |
|---------------------------------------|---------------------------|
| Obs. Alt. $60^{\circ} 23' 14''$ | S. D. $- 16' 00''$ |
| Corr. $- 24 \ 12$ | I. C. $- 2 \ 21$ |
| | Ref. $- \ 33$ |
| True Alt. $59 \ 59 \ 02$ | Dip $- 5 \ 22$ |
| $\ 90 \ 00 \ 00$ | Par. $+ \ 4$ |
| M. Z. D. $30 \ 00 \ 58 \text{ S.}$ | |
| True Dec. $23 \ 24 \ 15.8 \text{ N.}$ | Corr. $- 24 \ 12$ |
| Latitude $6 \ 36 \ 42.2 \text{ S.}$ | |
| Dec. $23^{\circ} 24' 00'' \text{ N.}$ | Hr. Diff. $4''$ |
| Corr. 15.8 | Long. 3.95 hrs. |
| True Dec. $23 \ 24 \ 15.8 \text{ N.}$ | Corr. $+ 15''.80$ |

At sea October 3, 1887, in longitude $67^{\circ} 30' \text{ W.}$, the observed meridian altitude of the sun's lower limb was $40^{\circ} 23' 50''$; sun bearing N.; index correction $+ 1' 30''$; height of the eye $18\frac{1}{2}$ feet. Find the latitude.

| | |
|--------------------------------------|--------------------------|
| Obs. Alt. $40^{\circ} 23' 50''$ | S. D. $+ 16' 00'$ |
| Corr. $+ 12 \ 20$ | I. C. $+ 1 \ 30$ |
| | Ref. $- 1 \ 07$ |
| True Alt. $40 \ 36 \ 10$ | Dip $- 4 \ 11$ |
| $90 \ 00 \ 00$ | Par. $+ \ 08$ |
| M. Z. D. $49 \ 23 \ 50 \text{ S.}$ | Corr. $+ 12 \ 20$ |
| True Dec. $4 \ 00 \ 21 \text{ S.}$ | |
| Latitude $53 \ 24 \ 11 \text{ S.}$ | |
| Dec. $3^{\circ} 56' 00'' \text{ S.}$ | Hr. Diff. $58''$ |
| Corr. $+ 4 \ 21$ | Long. 4.5 hrs. |
| True Dec. $4 \ 00 \ 21 \text{ S.}$ | 290 |
| | 232 |
| | $261''0$ |
| | Corr. $+ 4' 21''$ |

At sea Feb. 21, 1888, in longitude 45° W. , the observed meridian altitude of the sun's lower limb was $55^{\circ} 43' 10''$; sun

bearing S.; index correction $-2' 10''$; height of the eye 19 feet. Find the latitude.

Obs. Alt. $55^{\circ} 43' 10''$

Corr. $+ 8 59$

True Alt. $55 52 09$

$90 00 00$

M. Z. D. $34 07 51$ N.

True Dec. $10 35 18$ S.

Latitude $23 32 33$ N.

Dec. $10^{\circ} 38' 00''$ S.

Corr. $- 2 42$

True Dec. $10 35 18$ S.

S. D. $+ 16' 00''$

I. C. $- 2 10$

Ref. $- 40$

Dip $- 4 16$

Par. $+ 5$

Corr. $+ 8 59$

Hr. Diff. $54''$

Long. 3 hrs.

$162''$

Corr. $- 2' 42''$

At sea Jan. 23, 1888, in longitude 4 hours and 12 minutes E., the observed meridian altitude of the sun's lower limb was $77^{\circ} 15' 30''$; sun bearing N.; index correction $-3' 10''$; height of the eye 19 feet. Find the latitude.

Obs. Alt. $77^{\circ} 15' 30''$

Corr. $+ 8 23$

True Alt. $77 23 53$

$90 00 00$

M. Z. D. $12 36 07$ S.

True Dec. $19 32 27$ S.

Latitude $32 08 27$ S.

Dec. $19^{\circ} 30' 00$ S.

Corr. $+ 2 27$

True Dec. $19 32 27$ S.

S. D. $+ 16' 00''$

I. C. $- 3 10$

Ref. $- 0 13$

Dip $- 4 16$

Par. $+ 0 02$

Corr. $+ 8 23$

Hr. Diff. $35''$

Long. 4.2 hrs.

70

170

$147''.0$

Corr. $+ 2' 27''$

At sea April 20, 1888, in longitude about $40^{\circ} 15'$ W., the observed meridian altitude of the sun's lower limb was 63°

01' 30''; sun bearing N.; index correction - 3' 10''; height of the eye 19 feet. Find the latitude.

Obs. Alt. 63° 01' 30''

Corr. + 8 09

True Alt. 63 09 39

90 00 00

M. Z. D. 26 50 21 S.

True Dec. 11 48 18 N.

Latitude 15 02 03 S.

Dec. 11° 46' 00'' N.

Corr. + 2 18

True Dec. 11 48 18 N.

S. D. + 16' 00''

I. C. - 3 10

Ref. - 0 29

Dip - 4 16

Par. + 0 04

Corr. + 8 09

Hr. Diff. 51''

Long. 2.7 hrs.

137''.7

Corr. + 2' 17''.7

CHAPTER VI.

TO FIND THE LONGITUDE.

THE earth in its revolution about its axes from west to east once in twenty-four hours causes the sun to pass over 360 degrees in that time, which is equal to 15 degrees per hour. As longitude is measured on the equator in degrees, minutes, and seconds, we have at once the connection between it and time, or 15° is equivalent to one hour, 15' to one minute, and 15'' to one second. As the motion of the sun is from east to west, apparently, it follows that all places east of us will have the sun on their meridian before it comes to ours, therefore it will be later there than at our place; and all places to the westward of us will have the sun on their meridian after it has passed ours, therefore it will be earlier there than at our place. Now, it has been stated, the first meridian, from which all longitudes are reckoned, is the one passing over Greenwich; hence the difference of time between Greenwich and any place is the longitude of that place. To find the longitude, then, of any place would be to find the time of the place and apply it to the Greenwich time.

As the sun, which is supposed to mark the days and hours by its passage in the heavens, is irregular in its motion, it is necessary to take into consideration, besides the two modes of counting dates, two kinds of time—*apparent time* and *mean time*.

Apparent Time is that shown by the sun, estimating the apparent noon the moment the sun passes the meridian, and if it were possible to determine that moment with accuracy at sea, we could then obtain the apparent time at ship; but the length of the days would vary as much as half an hour during the year if they were determined by the sun's passage over the meridian.

Mean Time. As it is impossible to construct watches or chronometers to show this apparent time, we make use of what is called mean time, which makes the days of uniform length throughout the year, and is therefore sometimes in advance of the time shown by the sun and sometimes behind it. This is the time shown by all well-regulated watches and chronometers.

Equation of Time. There is sometimes a difference of a quarter of an hour between this apparent and mean time. This difference is called the *equation of time*, and is given in Table IV at Greenwich noon for each day of the month, and must be applied to the apparent time according to the instructions given at the top of the column, in order to obtain the mean time. This equation of time found in Table IV must be corrected for the Greenwich time. In Table IVa, under the daily variation at the top and opposite the hour of Greenwich at the side, the number of seconds will be found to apply to the equation of time found in Table IV to obtain the correct equation of time.

The method of obtaining the apparent time at sea, and thence the mean time, is by observing the altitude of the sun, taken either in the forenoon or afternoon when it is rising or falling fastest, or when bearing nearly east or west, noting the time by watch at the same instant.

The preliminary steps in solving this problem will consist in finding the following data: the *correct Greenwich date* expressed astronomically, the *true altitude* of the sun, *latitude* of the place, and the *polar distance* of the sun.

The Greenwich date is found by comparing the watch with

the chronometer, which will give the time shown by the chronometer when the observation was taken; apply the error and rate of the chronometer and the Greenwich mean time is obtained.

The true altitude is found by correcting the observed altitude for semi-diameter, index correction, refraction, dip, and parallax in the same manner as explained for correcting the meridian altitude.

The latitude of the place is found by dead-reckoning from the last position to the time of observing the altitude. It is sometimes the practice to observe an altitude in the morning for time and delay working till noon, when the meridian altitude gives the latitude which is worked back by dead-reckoning to the time of taking the observation.

The polar distance is the distance of the sun from the north pole when the observation is taken in north latitude, and its distance from the south pole when taken in south latitude.

Take from Table III the declination corresponding to the Greenwich date, and multiply the difference for one hour by the Greenwich time, which apply as before explained to obtain the true declination.

As the declination is the distance of the sun from the equator and the equator is 90° from the poles, it follows that the declination subtracted from 90 if of the same name as the latitude, or added if of a contrary name, will give the polar distance.

Having thus found the correct altitude, latitude, and polar distance, the apparent time of observation may be found by the following method and the use of Table V. In this table, if the sine or cosine sought is marked at the top of the page, the title, hour A.M. or P.M., is also found at the top, and the contrary if the sine or cosine is marked at the bottom.

Add together the altitude, latitude, and polar distance and take half their sum; from this half sum subtract the altitude and note the remainder. Take from Table V the secant of the latitude, the cosecant of the polar distance (rejecting 10 in the index), the cosine of the half sum, and the sine of the remainder; add these together and take half the sum, which seek for in the column of sines, and opposite to it will be the corresponding apparent time.

Take from Table IV the equation of time corresponding to the Greenwich date, corrected for Greenwich time by Table

IVa, and apply it to this apparent time according to the directions at the top of the column, and we shall obtain the mean time of the observation. Take the difference between this and the Greenwich time, and the result is the longitude *east* when the Greenwich time is the least, and *west* if the Greenwich time is greater than the time of the place.

EXAMPLE.

On Nov. 9, 1889, in the forenoon, the observed altitude of the sun's lower limb was $22^{\circ} 29' 20''$; height of the eye 17 feet; index correction $+ 2' 45''$; watch time of observation $8^h 51^m 57^s$ A.M.; slow of chronometer time $4^h 54^m 15^s$; chronometer correction $- 2^m 12^s$; with latitude by dead-reckoning 35° North. Find the longitude.

PREPARATION OF DATA.

| | |
|-------------------------------|---------------------------------|
| W. Time $8^h 51^m 57^s$ A.M. | Obs. Alt. $22^{\circ} 29' 20''$ |
| C.—W. $4 \ 54 \ 15$ | S. D. $+ 16 \ 00$ |
| | I. C. $+ \ 2 \ 45$ |
| C. Time $1 \ 46 \ 12$ P.M. | Ref. $- \ 2 \ 20$ |
| C. Corr. $- \ 2 \ 12$ | Dip $- \ 4 \ 02$ |
| | Par. $+ \ \ \ 8$ |
| G. M. T. $1 \ 44 \ 00$ P.M. | True Alt. $22 \ 41 \ 51$ |
| Dec. $17^{\circ} 00' 00''$ S. | Diff. $1^h 43''$ |
| Corr. $+ \ 1 \ 13$ | G. M. T. 1.7 |
| True Dec. $17 \ 01 \ 13$ S. | Corr. 73.1 |
| $90 \ 00 \ 00$ | or $+ \ 1' 13''$ |
| Pol. Dist. $107 \ 01 \ 13$ | |

SOLUTION.

| | |
|----------------------------|-----------------|
| Alt. $22^{\circ} 41' 51''$ | |
| Lat. $35 \ 00 \ 00$ | sec 0.08664 |
| Pol. Dist. $107 \ 01 \ 13$ | cosec 0.01945 |
| Sum $164 \ 43 \ 04$ | |
| Half Sum $82 \ 21 \ 32$ | cos 9.12374 |
| Alt. $22 \ 41 \ 51$ | |
| Rem. $59 \ 39 \ 41$ | sin 9.93604 |
| | $2)19.16587$ |
| | sin 9.58293 |

Local App. Time $8^h 59^m 58^s$ A.M.Equation of Time $- 16 \ 01$ Local M. Time $8 \ 43 \ 57$ A.M.Gr. M. Time $1 \ 44 \ 00$ P.M.Diff. Time $5 \ 00 \ 03$ Longitude $75^\circ 00' 45''$ W.Equation of Time, Table IV, $- 16^m 02^s$ Daily Variation 6^s Correction, Table IVa, $- 1$ Equation of Time $- 16 \ 01$

About 8 A.M. April 3, 1888, in latitude $20^\circ 45'$ S. and east longitude, the observed altitude of the sun's lower limb was $24^\circ 37' 10''$; index correction $+ 2' 20''$; height of the eye 19 feet; watch time of observation $7^h 57^m 07^s.5$; slow of chronometer time $5^h 57^m 24^s$; chronometer correction $- 3^m 38^s$. Find the longitude.

PREPARATION OF DATA.

W. Time $7^h 57^m 07^s.5$ C.—W. $5 \ 57 \ 24$ C. Time $1 \ 54 \ 31.5$ C. Corr. $- 3 \ 38$ G. M. T. $3d \ 13 \ 50 \ 53.5$ Obs. Alt. $24^\circ 37' 10''$ S. D. $+ 16 \ 00$ I. C. $+ 2 \ 20$ Ref. $- 2 \ 06$ Dip $- 4 \ 16$ Par. $+ 0 \ 08$ True Alt. $24 \ 49 \ 16$ Dec. $5^\circ 35' 00''$ N.Corr. $+ 13 \ 06$ True Dec. $5 \ 48 \ 06$ N. $90 \ 00 \ 00$ Pol. Dist. $95 \ 48 \ 06$ Hr. Diff. $57''$ G. M. T. 13.8 hrs. 786.6 Corr. $+ 13' 06''.6$

SOLUTION.

Alt. $24^\circ 49' 16''$ Lat. $20 \ 45 \ 00$ Pol. Dist. $95 \ 48 \ 06$ Sum $141 \ 22 \ 22$ sec 0.02913 cosec 0.00223

| | | | |
|------------------|---|-----|-------------------|
| Half Sum | 70 41 11 | cos | 9.51948 |
| Alt. | 24 49 16 | | |
| Rem. | <u>45 51 55</u> | sin | 9.85594 |
| | | | <u>2)19.40678</u> |
| Local App. Time | 7 ^h 57 ^m 17 ^s A.M. | sin | 9.70339 |
| Equation of Time | + 3 00 | | |
| Local M. Time | <u>8 00 17</u> A.M. | | |
| Gr. M. Time | 1 50 53.5 A.M. | | |
| Diff. Time | 6 09 23.5 | | |
| Longitude | 92° 20' 33" E. | | |

Equation of Time, Table IV, + 3^m 10^sDaily Variation 18^s.

Correction, Table IVa, - 10

Equation of Time + 3 00

About 8 A.M. Feb. 21, 1888, in latitude 24° 10' N. and west longitude, the observed altitude of the sun's lower limb was 21° 44' 10"; index correction - 2' 10"; height of the eye 19 feet; watch time of observation 8^h 01^m 12^s; slow of chronometer time 3^h 04^m 07^s; chronometer correction + 7^m 35^s. Find the longitude.

PREPARATION OF DATA.

| | | | |
|------------|---|-----------|---------------|
| W. Time | 8 ^h 01 ^m 12 ^s A.M. | Obs. Alt. | 21° 44' 10" |
| C.—W. | <u>3 04 07</u> | S. D. | + 16 00 |
| | | I. C. | - 2 10 |
| C. Time | 11 05 19 A.M. | Ref. | - 2 25 |
| C. Corr. | <u>+ 7 35</u> | Dip | - 4 16 |
| | | Par. | <u>+ 0 08</u> |
| G. M. T. | 22d 23 12 54 | True Alt. | 21 51 27 |
| or | | | |
| 21st | - 0 ^h .79 | | |
| Dec. | 10° 38' 00" S. | Hr. Diff. | 54" |
| Corr. | <u>+ 43</u> | G. M. T. | <u>- 79</u> |
| True Dec. | 10 38 43 S. | Corr. | + 42.66 |
| | <u>90 00 00</u> | | |
| Pol. Dist. | 100 38 43 | | |

SOLUTION.

| | | | |
|------------|-------------|-------|---------|
| Alt. | 21° 51' 27" | | |
| Lat. | 24 10 00 | sec | 0.03983 |
| Pol. Dist. | 100 38 43 | cosec | 0.00754 |

Sum 146 40 10

Half Sum 73 20 05 cos 9.45754

Alt. 21 51 27

Rem. 51 28 38 sin 9.89340

2)19.39831

Local App. Time 7^h 59^m 53^s A.M. sin 9.69915

Equation of Time + 13 53

Local M. Time 8 13 46 A.M.

Gr. M. Time 11 12 54 A.M.

Diff. Time 2 59 08

Longitude 44° 47' 00" W.

Equation of Time, Table IV, + 13^m 53^s

Daily Variation 0^s.

Correction, Table IVa, 0

Equation of Time + 13 53

On April 3, 1888, in the forenoon, in latitude 29° 42' 30" S. and east longitude, the observed altitude of the sun's lower limb was 22° 41' 30"; index correction - 2' 30"; height of the eye 24 feet; watch time of observation 8^h 06^m 20^s.5; slow of chronometer time 8^h 08^m 14^s; chronometer correction - 6^m 19^s. Find the longitude.

PREPARATION OF DATA.

W. Time 8^h 06^m 20^s.5 A.M. Obs. Alt. 22° 41' 30"

C W. 8 08 14 S. D. + 16 00

I. C. - 2 30

C. Time 4 14 34.5 Ref. - 2 19

C. Corr. - 6 19 Dip - 4 48

Par. + 08

G. M. T. 2d 16 08 15.5

or

True Alt. 22 48 01

3d - 7^h.86,

| | | | |
|------------|---------------|-----------|----------|
| Dec. | 5° 35' 00" N. | Hr. Diff. | 57" |
| Corr. | — 7 28 | G. M. T. | — 7.86 |
| <hr/> | | <hr/> | |
| True Dec. | 5 27 32 N. | Corr. | 448.02 |
| | 90 00 00 | | or |
| | <hr/> | | — 7' 28" |
| Pol. Dist. | 95 27 32 | | |

SOLUTION.

| | | | |
|-----------------|---|-------|------------|
| Alt. | 22° 48' 01" | | |
| Lat. | 29 42 30 | sec | 0.06120 |
| Pol. Dist. | 95 27 32 | cosec | 0.00198 |
| <hr/> | | <hr/> | |
| Sum | 147 58 03 | | |
| <hr/> | | <hr/> | |
| Half Sum | 73 59 01 | cos | 9.44077 |
| Alt. | 22 48 01 | | |
| <hr/> | | <hr/> | |
| Rem. | 51 11 00 | sin | 9.89162 |
| | | | 2)19.39557 |
| Local App. Time | 8 ^h 00 ^m 43 ^s A.M. | sin | 9.69778 |
| Equation Time | + 3 15 | | |
| <hr/> | | <hr/> | |
| Local M. Time | 8 03 58 A.M. | | |
| Gr. M. Time | 4 08 15.5 A.M. | | |
| <hr/> | | <hr/> | |
| Diff. Time | 3 55 42.5 | | |
| Longitude | 58° 55' 37" E. | | |

Equation of Time, Table IV, + 3^m 10^sDaily Variation 18^s.

Correction Table IVa, + 5

Equation of Time + 3^m 15^s

CHAPTER VII.

A SUMNER.

It has already been said the sun should be observed for time when bearing nearly east or west, for then the altitude cannot only be observed with more accuracy and the time noted more exactly when the sun is rising or falling the fast-

est, but the longitude can be found without the necessity of the latitude being accurately known; in fact an uncertainty of two or three degrees in the latitude would not make much difference in the time derived from the observation.

As the sun begins to move away from the east or west points the error in the latitude begins to affect the longitude more and more, until at north or south a very slight difference in the latitude makes a great difference in the longitude.

The sun can only pass the east or west points when its declination is of the same name as the latitude; but when they are of contrary names the sun cannot bear east or west, but will come nearer to those points at rising or setting, at which time the low altitude is too much affected by the excessive refraction. In either case clouds and other causes will often interfere to prevent the observation being taken at or near the proper bearing; hence it is plain the latitude should be accurately known.

Now it will often happen that a meridian altitude for latitude cannot be had for several days, while at the same time dead-reckoning must be relied upon to work the latitude up to the time of the observation, from which an error is sure to follow. It remains, then, to show what use can be made of the sun to find the position of the ship when the sun occupies a place neither east nor west nor on the meridian. This brings us now to the most important problem in navigation, and one which is universally used at sea, called "**a sumner.**"

This method consists in working the observation, when the latitude is uncertain, with two assumed latitudes, the one a little greater and the other a little less than the latitude we are supposed to be in, by which one observation for time enables us to find the bearing of land, and two observations, between which the sun has changed its bearing, will give us both the latitude and longitude provided the chronometer is right or its error and rate are known.

Circles of Equal Altitudes. At any given instant the sun is vertically above some point on the earth's surface. At this spot an observer with a sextant would find the true altitude of the sun's centre to be 90 degrees. If, however, the observer should shift his position away from the sun, its distance from his zenith would of course become greater and its altitude less. He would then be situated upon a small circle

the centre of which would be the spot under the sun. All persons on that circle would have the sun at an equal altitude. Finally, when he came to the horizon, all points on the circle would have the sun in the horizon. These circles of equal altitudes cut the various parallels of latitude and meridians at different angles. Near the east and west points the circles run up and down nearly with the meridians; so that if the observer were at the east or west points of the circle it would make little difference whether the latitude were exact or not, for there the longitude remains nearly the same for a long distance in latitude. Near the north and south points the circles run nearly east and west with the parallels of latitude; so that if he were at one of those points of the circle, a very slight difference in the latitude would make a great difference in the longitude. Hence it follows if an observer had a certain altitude we see that different latitudes would put him at different points of his circle of equal altitudes, and that these points would differ in longitude, at first slowly when near east or west, and then more rapidly as the point approached north or south.

Line of Position. As the circles are so large, compared with the difference between the latitudes which are used, this portion of the circle may be regarded as a straight line, which line is called a **line of position**, and *is always at right angles to the bearing of the sun.*

To obtain this line of position in actual practice, assume a latitude which is 10 to 30 minutes greater than that by dead-reckoning and a latitude 10 to 30 minutes less, and from each of these work out the observation for time. From the two resulting longitudes and the latitude of each, plot the positions on the chart and connect them by a straight line; we shall then have a line on which the ship is somewhere.

If this line runs parallel to the coast, its distance is approximately known, and the bearing of some known point on shore or a cast of the lead will give the position on the line. If the line on the chart be extended till it meets a point of land, it shows the bearing of that point. Although the exact distance of this point is unknown, yet we have only to sail on this line till the point is reached. Thus it is seen how with one observation the ship may be kept out of the danger whose bearing or distance is not exactly known.

If, after the sun has changed its bearing not less than three points,—but the nearer to eight points the better,—we should take another observation, it will give, by working in the same manner, a second line of position, which must cross the first one at some point, as they are each at right angles to the sun at the moment of observation. If the ship has not changed her position between the observations, the point of intersection of the two lines of position will be the position of the ship. But in practice the ship is very seldom stationary between the observations, and to find her position at the moment of the last one, lay off on the chart from the first line of position the course and distance made good between the two observations, and draw a parallel line to this first line of position; then the ship would be somewhere on the parallel line after having sailed a certain distance in a given direction. As the ship is also on the second line of position, its intersection with the parallel line will be the position of the ship at the moment of taking the second observation.

If the two lines of position do not intersect, the latitudes used were not far enough apart, and the lines must be prolonged till they do meet.

EXAMPLES.

On Nov. 9, 1889, in the forenoon, in latitude $34^{\circ} 40' N.$ by dead-reckoning, observed the altitude of the sun's lower limb $22^{\circ} 29' 20''$; watch time of observation $8^h 51^m 57^s$ A.M., slow of chronometer time $4^h 54^m 15^s$; chronometer correction $-2^m 12^s$; height of the eye 17 feet; index correction $+2^{\circ} 45'$. Find the line of position. Assume the latitudes $34^{\circ} 10'$ and $35^{\circ} 10' N.$

PREPARATION OF DATA.

| | |
|-------------------------------|---------------------------------|
| W. Time $8^h 51^m 57^s$ A.M. | Obs. Alt. $22^{\circ} 29' 20''$ |
| C.—W. $4\ 54\ 15$ | S. D. $+16\ 00$ |
| | I. C. $+2\ 45$ |
| C. Time $1\ 46\ 12$ P.M. | Ref. $-2\ 20$ |
| C. Corr. $-2\ 12$ | Dip $-4\ 02$ |
| | Par. $+8$ |
| Gr. M. T. $1\ 44\ 00$ P.M. | True Alt. $22\ 41\ 51$ |
| Dec. $17^{\circ} 00' 00''$ S. | Diff. $1\ hr. 43''$ |
| Corr. $+1\ 13$ | G. M. T. 1.7 |

True Dec. 17 01 13 S.
 90 00 00

Corr. 73''.1
 or 1' 13''

Pol. Dist. 107 01 13

SOLUTION.

| | | |
|------------|------------------|---------------|
| Alt. | 22° 41' 51'' | |
| Lat. | 34 10 00 | sec 0.08228 |
| Pol. Dist. | 107 01 13 | cosec 0.01945 |
| Sum | <u>163 53 04</u> | |
| Half Sum | 81 56 32 | cos 9.14669 |
| Alt. | <u>22 41 51</u> | sin 9.93417 |
| Rem. | 59 14 41 | |

2)19.18259

sin 9.59129

| | | |
|-------|--------------|---------------|
| Alt. | 22° 41' 51'' | |
| Lat. | 35 10 00 | sec 0.08752 |
| P. D. | 107 01 13 | cosec 0.01945 |

Sum 164 53 04

| | | |
|----------|-----------------|-------------|
| Half Sum | 82 26 32 | cos 9.11901 |
| Alt. | <u>22 41 51</u> | |
| Rem. | 59 44 41 | sin 9.93641 |

2)19.16239

sin 9.58119

L. A. T. 8^h 56^m 16^s
 Eq. T. — 16 01

L. A. T. 9^h 00^m 43^s
 Eq. T. — 16 01

L. M. T. 8 40 15 A.M.
 G. M. T. 1 44 00 P.M.

L. M. T. 8 44 42 A.M.
 G. M. T. 1 44 00 P.M.

Diff. T. 5 03 45

Diff. T. 4 59 18

or

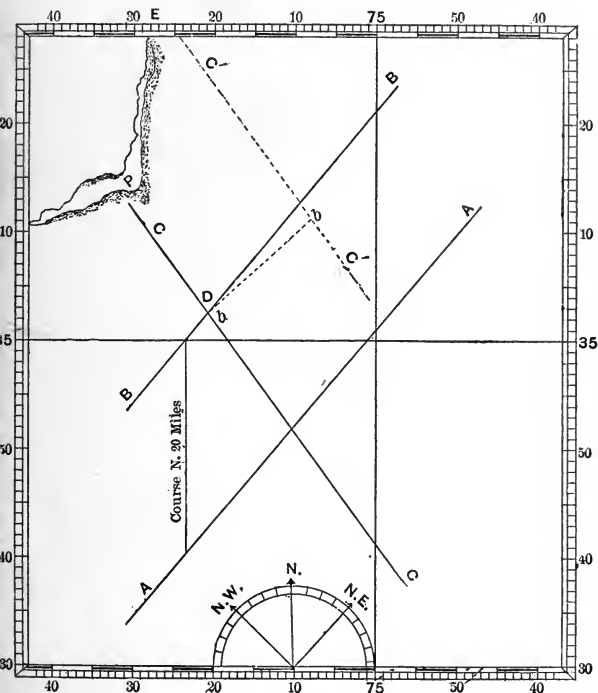
or

Longitude 75° 56' 15'' W.

Longitude 74° 49' 30'' W.

Plot these two positions on the chart and connect them by a straight line which gives a line of position *AA*, and if the

observation was good and the chronometer right, the ship is on this line somewhere. Although the exact position on the line is not known, its direction affords an accurate knowledge of the least possible distance the ship can be from the point of danger *P*.



After determining the line of position by the forenoon observation, the ship was headed due north, but at noon a meridian altitude for latitude could not be got, and the latitude by dead-reckoning being too uncertain, another observation was taken about 4 P.M., the ship having made good 20 miles in the interval. The observed altitude of the sun's lower limb was $17^{\circ} 44' 10''$; watch time of observation $4^h 04^m 53^s$ P.M., slow of

chronometer time $4^h 12^m 20^s$; chronometer correction $-2^m 12^s$; height of the eye 17 feet; index correction $+2' 45''$. Find the second line of position and the position of the ship. The latitude by dead-reckoning being 35° N., assume the latitudes $34^\circ 30'$ and $35^\circ 30'$ N.

PREPARATION OF DATA.

| | |
|------------------------------|-------------------------------|
| W. Time $4^h 04^m 53^s$ | Obs. Alt. $17^\circ 44' 10''$ |
| C.—W. $4 \ 12 \ 20$ | S. D. $+ 16 \ 00$ |
| <hr/> | I. C. $+ 2 \ 45$ |
| C. Time $8 \ 17 \ 13$ P.M. | Ref. $- 3 \ 01$ |
| C. Corr. $- 2 \ 12$ | Dip $- 4 \ 02$ |
| <hr/> | Par. $+ \quad \cdot 8$ |
| Gr. M. T. $8 \ 15 \ 01$ P.M. | Tr. Alt. $17 \ 56 \ 00$ |
| Dec. $17^\circ 00' 00''$ S. | Diff. $1 \text{ hr. } 43''$ |
| Corr. $+ 6 \ 54$ | G. M. T. $8 \ 25$ |
| <hr/> | <hr/> |
| True Dec. $17 \ 06 \ 54$ S. | Corr. $354''.75$ |
| $90 \ 00 \ 00$ | $+ 6' \ 54''$ |
| <hr/> | |
| Pol. Dist. $107 \ 06 \ 54$ | |

SOLUTION.

| | |
|------------------------------|---------------|
| Alt. $17^\circ 56' 00''$ | |
| Lat. $34 \ 30 \ 00$ | sec 0.08401 |
| P. D. $107 \ 06 \ 54$ | cosec 0.01968 |
| <hr/> | |
| Sum $159 \ 32 \ 54$ | |
| <hr/> | |
| Half Sum $79 \ 46 \ 27$ | cos 9.24927 |
| Alt. $17 \ 56 \ 00$ | |
| <hr/> | |
| Rem. $61 \ 50 \ 27$ | sin 9.94529 |
| | <hr/> |
| | 2)19.29825 |
| | <hr/> |
| | sin 9.64912 |
| Alt. $17^\circ 56' 00''$ | |
| Lat. $35 \ 30 \ 00$ | sec 0.08931 |
| P. D. $107 \ 06 \ 54$ | cosec 0.01968 |
| <hr/> | |
| Sum $160 \ 32 \ 54$ | |

Half Sum 80 16 27
 Alt. 17 56 00

 Rem. 62 20 27

cos 9.22737

 sin 9.94730

 2)19.28366

 sin 9.64183

L. A. T. 3^h 31^m 47^s
 Eq. T. — 16 01

L. A. T. 3^h 28^m 00^s
 Eq. T. — 16 01

 L. M. T. 3 15 46 P.M.
 G. M. T. 8 15 01 P.M.

 L. M. T. 3 11 59 P.M.
 G. M. T. 8 15 01 P.M.

 Diff. T. 4 59 15
 or

 Diff. T. 5 03 02
 or

Longitude 74° 48' 45" W.

Longitude 75° 45' 30" W.

From any point on the line of position *AA*, set off the true course north, and the distance 20 miles made good in the interval, and through the spot draw the parallel line *BB*. Then plot the two positions by the P.M. observation on the chart, and connect them by a straight line which will give a second line of position *CC*. The point *D* where it cuts the parallel line *BB* will be the position of the ship at the moment of the second observation.

Had there been no other line of position, *CC* prolonged would give the bearing of the point of land or danger *P*; and though its distance would not be accurately known, the soundings might give it: hence the danger could be avoided by shaping a course in a direction away from the line of position.

Should it be intended to dodge the point of land and make a port *E* on the other side, draw a parallel line *C'C'* to *CC* through *E*, and with the dividers measure the shortest distance *bb* between *CC* and *C'C'*; run that distance on a course perpendicular to *CC*; then by changing the course in the direction of *C'C'* the vessel will make the port *E* right ahead.

Had it been possible to obtain a meridian altitude for latitude, we could have laid off from the first line of position the course and distance made good from the time of observation to noon, and then drawn a parallel to *AA*. The spot where

the noon latitude cut the parallel would have been the position of the ship at noon.

It will be seen by an inspection of Table V that the cosine of 90 degrees and the sine of zero degrees are indeterminate; hence the nearer the half sum approaches 90 degrees or the remainder zero, the more indeterminate or uncertain the longitude obtained will be.

This will occur when the sun is near the meridian. Should the half sum exceed 180 degrees, or be less than the latitude, the assumed latitudes will be beyond the circle of equal altitudes, and other latitudes must be taken nearer the one that will give a resulting longitude.

CHAPTER VIII.

COMPASS ADJUSTMENT.

IN a wooden vessel the deviations of the compass are usually so small that the compass can be easily corrected for all practical purposes; but in iron ships the deviations are not only very large, but they are so irregular that the vessel cannot be safely navigated unless the compass is what is termed *adjusted*. To understand this it is necessary to consider the elementary laws of magnetism.

The Earth a Magnet. A magnet has two poles of dissimilar nature and equal strength, separated by a neutral line over which neither pole has any influence. The earth may be considered as an immense magnet, having two north and two south magnetic poles. The strongest of these magnetic poles lies, the one in about latitude 70 degrees north, longitude 95 degrees west, and the other in about latitude 70 degrees south, longitude 145 degrees east. These two poles are of different polarities, and are denominated the north and south magnetic poles of the earth.

Magnetic Equator. The neutral line separating the two polarities, called the Magnetic Equator, is an irregular curve running round the earth not far from the earth's equator, crossing it in two places—one near the west coast of Africa in the Atlantic Ocean, the other nearly in the middle of the Pacific Ocean.

Poles of the Magnet. If a magnet be freely suspended by a thread, one end will point nearly to the north pole, the other to the south pole, of the earth. The end of the magnet pointing to the north is called its north pole, and the end pointing to the south is called its south pole.

Attraction and Repulsion of the Poles. If we take two magnets and present the north pole of the one to the north pole of the other, they will repel each other ; but if the north pole of the one be placed near the south pole of the other they will attract each other : like poles repel and unlike poles attract each other.

Induced Magnetism. If we take a piece of soft iron and place it near the north pole of a magnet, the iron will be attracted by the magnet ; the same effect will follow if the iron be placed near the south pole. This effect is produced by a temporary communication of magnetism to the soft iron by the magnet. It is called *induction*, and the pieces of soft iron thus magnetized are called *induced magnets*, to distinguish them from permanent magnets. Before any pole of a magnet can attract iron, it must first induce an opposite pole in the part of iron held nearest it. It is not necessary that the magnet and a piece of iron should be actually in contact to cause induction.

Influence of the Earth's Magnetism. The earth as a magnet has the power of inducing magnetism in bars of iron exposed to its influence in the same manner as other magnets.

Magnetic Dip. Near the magnetic equator a freely suspended magnet will remain in a horizontal position ; but if carried northward towards the magnetic pole of the earth, the north end will gradually point downward until at the magnetic pole the magnet will become vertical. In the same manner, if the magnet be carried into the southern hemisphere the south end will gradually point downward, until at the magnetic pole the magnet will become vertical. This inclination of the magnet at any place is called the *dip* at that place.

The Earth's Line of Force is the direction which a freely suspended needle takes, the needle being horizontal at the magnetic equator and vertical at the magnetic poles. The line of force at any place is in the line of dip at that place, and is the most favorable position in which an iron bar can be placed to receive induced magnetism from the earth. A soft iron bar placed lengthwise in the line of force or held hori-

zontally in a north and south direction receives induced magnetism instantly, but parts with it quickly if it be held in an east and west direction at right angles to the magnetic meridian. Hard iron requires a longer period to receive magnetism by induction, and does not part with it so soon ; it may even retain a part of its magnetism permanently.

Effect of Vertical Iron. In north magnetic latitude the upper end of vertical soft iron will attract the north pole of a magnetic needle held near it ; on the other hand, in south magnetic latitude the upper end of vertical iron will attract the south pole of the needle, and repel the pole of the needle it had previously attracted. On the magnetic equator vertical soft iron has no effect because its position is at right angles to the line of force.

Effect of Horizontal Iron. A horizontal bar of soft iron at the magnetic poles has no magnetism, since there it is at right angles to the line of force. When taken, however, into low latitudes it gradually becomes magnetic if kept pointing towards the magnetic pole, and has the greatest power in the vicinity of the magnetic equator.

An Iron Ship a Magnet. Every iron ship is a magnet, the character of the magnetism and the position of the poles depending upon the value of the dip at the place of building and the direction in which the keel lay during the construction of the ship. The magnetic intensity of the vertical soft iron, such as the rudder-post, will remain the same, no matter what may be the direction of the ship's head ; but its disturbing effect on the compass depends upon its position relative to the needle, being greatest when at right angles to the direction of the needle's length and ceasing when in line with it ; whereas horizontal iron on board ship has a varying action on the compass, depending on the direction of the ship's head as well as the position of its poles relative to the compass needle.

Subpermanent Magnetism. After launching and reversal of the ship's head the magnetism undergoes rapid diminution ; but in no case does it depart entirely. That which is left is called *subpermanent*. It is evident that the position of the poles of the ship's subpermanent magnetism must depend upon the direction of her head when building, and upon the dip at the part of the world in which she was built. If, for example, a ship were built with her head north

magnetic in north latitude where the dip is about 60 degrees, her magnetic condition would be shown in Fig. 1.

The line marked *dip* is the direction of the earth's lines of magnetic force. The line marked *neutral* is the line of no deviation, and runs at right angles to the dip. The shaded portion of the ship possesses south polarity, attracting the

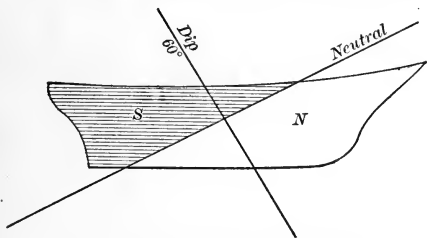


FIG. 1.—HEAD NORTH WHILE BUILDING.

north pole of the compass needle ; the white portion below the neutral line possesses north polarity, repelling the north pole of a compass needle. Hence, if a compass be placed outside of and near the ship, above the line of no deviation, the north pole of the compass needle will be attracted ; if it be placed below that line, the north pole will be repelled and the south pole attracted.

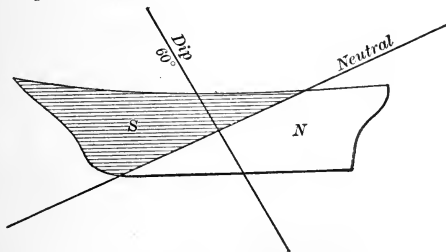


FIG. 2.—HEAD SOUTH WHILE BUILDING.

If the ship had been built with her head south, the condition would be as in Fig. 2.

In this case the after part of the ship possesses north polarity, and the forward part possesses south polarity.

If the ship's head had been west while building, her magnetical conditions would be shown in Fig. 3.

The starboard side below the neutral line would repel the north pole of a compass needle, while the port side above the neutral line would attract it.

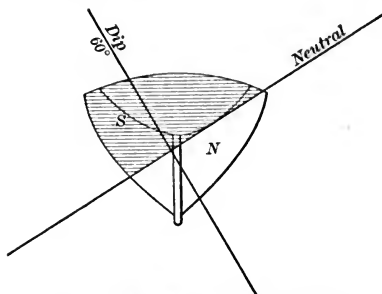


FIG. 3.—HEAD WEST WHILE BUILDING.

With the head east while building, the magnetical conditions would be the reverse, as in Fig. 4.

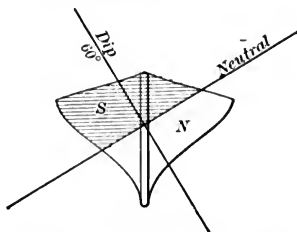


FIG. 4.—HEAD EAST WHILE BUILDING.

If the ship were built in south magnetic latitude, the shaded part showing south polarity lies below the neutral line, as in Fig. 5.

Two Kinds of Deviations. The error produced on the compass by the magnetism of an iron ship is of two descriptions, known as *semicircular* and *quadrantal* deviations. The semicircular is so called from being easterly in one semicircle and westerly in the other, as the ship's head moves round a complete circle. The quadrantal deviation is so called from its being easterly and westerly alternately in the four quadrants as the ship's head moves around a complete circle.

Semicircular Deviation is caused by the subpermanent magnetism in the ship and by the induced magnetism in vertical iron. There is little or no semicircular deviation from subpermanent magnetism with a ship's head on or near the points of the compass to which her head and stern were directed while building; and it is greatest on the points that

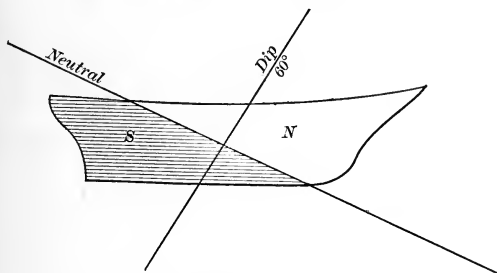


FIG. 5.—IN SOUTH MAGNETIC LATITUDE.

were nearly abeam of the ship while building. It changes as the ship changes her magnetic latitude, and that part of it which is caused by the induced magnetism of vertical iron disappears when a ship is near the magnetic equator, and is reversed when a ship passes into south magnetic latitude.

To illustrate the way in which the subpermanent magnetism and the induced magnetism of vertical iron acts upon the compass to produce semicircular deviation, let it be supposed that the whole of the *south* polarity of the above magnetism is concentrated in the point *A*, Fig. 6, on the port quarter of a ship built with her head NW.; this south pole will attract the north end of a compass needle and repel the south end.

In Fig. 6, the ship is supposed to be swung round, the compass beginning at the NW. point. The small circles represent the compass; the thick lines, *n.s.*, the compass needle; the dotted line, *N.S.*, the magnetic meridian or the direction of the needle when free from deviation. Beginning at the NW., and noting the position of *A*, it will be observed that there can be no semicircular deviation with the ship's head in that direction, because the attractive force of the ship's magnetism at the point *A* is in line with the compass needle *n.s.* As the ship's head swings round towards the west the

relative positions of the point *A* and the compass needle will alter, and *A* will exert forces upon the needle, causing it to deviate to the right from *N.* to *n.*, shown in the figure at west.

The easterly deviation will increase until the ship's head swings to near SW., where it attains its maximum, or greatest, amount. After passing the point of greatest deviation, it gradually decreases until the ship's head reaches SE., the

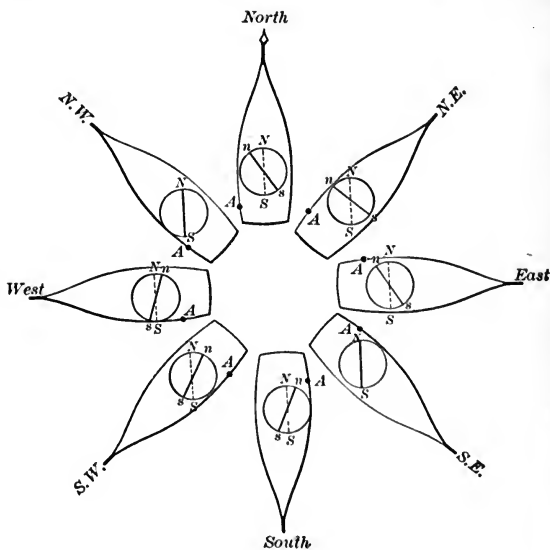


FIG. 6.

opposite direction to that in which her head was built, where it is again nothing. As the ship's head comes towards the east the needle will gradually be drawn to the left hand until the westerly direction becomes greatest at near NE., and will then decrease until the head reaches NW., the point of no deviation. From this it will be seen that in the semicircle from NW. round by west to SE. the deviation is easterly, while in the semicircle from SE. round by east to NW. the deviation is westerly.

No two ships are alike in their influence on the compass, nor

will the ship's magnetism have the same effect on two compasses placed in different parts of the deck. However, the same principle of correction will apply to all; that is, the permanent portion of the ship's magnetism, which causes semicircular deviation, is compensated by steel magnets, whose magnetism is likewise permanent; and that part due to induction in vertical iron, which comes and goes with change of latitude, and likewise causes semicircular deviation, is compensated by vertical tubes of ordinary wrought iron. These vertical tubes become magnetized by induction from the earth, the amount and kind of magnetism varying with the latitude, as in the vertical iron.

Quadrantal Deviation is caused by the induced magnetism of horizontal soft iron and is the same for all latitudes. To illustrate the way in which horizontal soft iron produces quadrantal deviation, let the whole of the horizontal soft iron in a ship be represented by the soft-iron bar *B* in Fig. 7.

Beginning at the north, it will be observed that the bar *B* is parallel with its magnetic meridian, and will therefore be an induced magnet while it is in or near that position; as it is in line with the compass needle *n.s.*, it cannot exert any deviating power upon the needle. As the ship's head swings towards the NW. the relative positions of the bar *B* and the needle *n.s.* are altered, and the south end of the bar draws the north pole of the needle to the left, from *N.* to *n.* As the ship's head approaches the west the bar *B* loses its force, and at west it is at right angles to the magnetic meridian, and ceases to exert any influence on the compass.

The ship's head now swings towards the SW., and the bar *B* as it turns towards the south pole again becomes an induced magnet; its after end being a north pole, draws the south pole of the compass needle from *S.* to *s.* When the ship's head reaches south there is no deviation again, because the bar *B* is in line with the needle.

As her head swings towards the SE. the needle is drawn from *S.* to *s.*, causing westerly deviation. At east there is no deviation, for the same reason that there was none at west. After passing east, the after end of *B* becomes a south pole and draws the north pole of the needle to the right; continuing on to the north, the quadrantal deviation decreases until it becomes nothing at north.

From this it will be seen that *B* produces easterly deviation in the NE. and SW. quadrants, and westerly deviations in the NW. and SE. quadrants. This deviation is compensated by hollow spheres of soft iron or boxes of wrought-iron chain placed athwartships and so that their centres may be as nearly as possible on the same level as the compass-needle.

Adjustment for Semicircular Deviation.—Choose a fine day and get the ship on an even keel. On the deck draw two chalk-lines, one fore and aft and the other athwartships, their

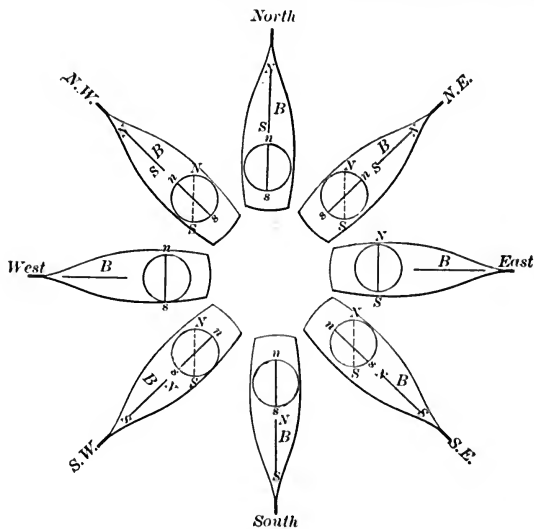


FIG. 7.

intersection being directly under the centre of the compass card. Let the ship's head be swung to the north or south, correct magnetic, and when steady at one of these points, observe whether there is any deviation; if there is any, lay one of the permanent compensating magnets on the deck athwartships with its centre exactly on the fore-and-aft line; move it to or from the foot of the binnacle until the compass points correctly. If the compass deviates to the left the north end of the magnet must be placed to the left, and conversely. If one

magnet is not sufficient to correct the deviation, apply another on the opposite side of the compass with similar poles in the same direction.

After the compass has been made to point correctly at either the north or south points, swing the ship's head to the east or west, correct magnetic, and steady on one of these points. Should there be any deviation now, it must be corrected partly by fore-and-aft magnets, and partly by an upright iron tube. How much is to be corrected by one and how much by the other is not easily ascertained, but the following will suffice : Place a permanent magnet on the deck fore and aft, either to starboard or port of the compass, with its centre upon the athwartship line ; move it slowly towards the binnacle till half the deviation is corrected. Next place the upright tube forward or abaft of the binnacle at such a distance as will correct the remaining half of the deviation, when it may be securely bolted down to the deck. If the deviation could be obtained on the east and west points when the ship is on the magnetic equator, and afterwards sail to a high latitude, where the deviation is again determined on those points, the difference will be the amount to be corrected by the vertical tubes. If, while on a cruise, it becomes necessary to readjust, the original positions of the magnets should always be marked, in order that the magnets may be replaced when required.

Adjustment for Quadrantal Deviation. Put the ship's head on any of the four magnetic points NE., SE., SW., or N.W. ; if there is any deviation, place a hollow cast-iron sphere on each side of the compass and move them nearer to or farther from it till the compass points correctly, being careful to have the centres of the spheres level with the needle, and each at same distance from centre of compass, and not to place the inner edge of the spheres any nearer the compass than the length of the needle. When this adjustment is properly made, it ought to remain perfect for all latitudes.

Heeling Error. The compass has now been adjusted with the ship on an even keel, but as the ship begins to heel over, either to starboard or port, the deviation is generally altered ; what was before horizontal iron inclines to a vertical position, receiving induced magnetism from the earth. The position of the vertical iron is also changed, producing a corresponding change of deviation.

This heeling error changes as the ship changes her latitude, and is greatest when the ship's head is north or south, and least when east or west by compass. The usual effect of the heeling error in north latitude, with a list on northerly courses, is to cause the ship to deviate from her apparent course in a direction towards the high side of the ship, and on southerly courses to deviate from her apparent course in a direction towards the lower side of the ship.

Adjustment for Heeling Error. The heeling error is corrected by a vertical permanent magnet placed in a suitable case in the vertical axis of the binnacle directly under the compass-needle, the case capable of being raised or lowered as required. After the horizontal correction of the compass with the ship upright, could the vessel be heeled, say, 10 degrees, the difference between the compass reading, ship upright and ship heeled, will give the deviation due to heel for the course steered at that time. It would be preferable to steady the ship's head at north or south magnetic. To correct this deviation insert the heeling magnet in the case and raise or lower it until the compass reads as on an even keel, when secure the magnet. Generally the north pole of the magnet should be uppermost in north latitudes, but the proper end is very easily determined on trial. As heeling error varies in change of latitude, this correction should be frequently readjusted, and the heeling magnet reversed end for end in changing hemispheres.

The compass by being adjusted is neither rendered absolutely correct nor insensible to change, but the error of the compass is reduced to within more manageable bounds. As above described, the compass when adjusted will appear as in Figs. 8 and 9.

Retentive Magnetism. There is one other part of the ship's magnetism, known as Retentive Magnetism, that plays a very important part in the deviation of the compass. This retentive magnetism is the temporary magnetism of the ship acquired by induction from the earth when the ship's head has been in one direction for a long time, either in dock or on a voyage. This magnetism is lost in the course of time by altering the deviation of the ship's head. The immediate effect of retentive magnetism is to cause the compass, on a change of the ship's course, to deviate in the direction of the last

course. In other words, if an iron ship has maintained a constant southerly course for some days, and then changes to the westward, the needle will be drawn to the left by retentive magnetism; that is, the deviation will be increased if westerly and diminished if easterly, causing the ship to steer to the southward of her intended course. It is impossible to

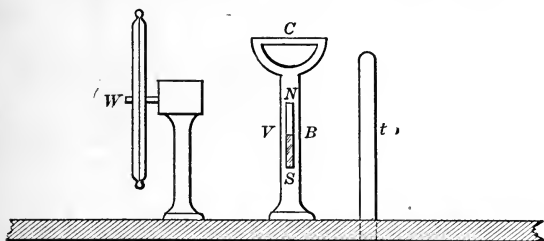


FIG. 8.—SIDE PLAN.

adjust the compass for retentive magnetism, hence its effect must be taken into account upon a change of course. If the vessel has maintained the same course for long time, before steering a new course the ship should be turned about a circle

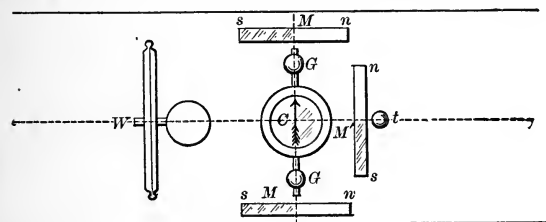


FIG. 9.—DECK PLAN.

and for a time steadied upon the point opposite to the original course.

In conclusion, the changes in the ship's magnetism, due to collisions, buffeting with the waves, tremor of the screw, retentive magnetism, and the effect on the compass of magnetic bottom in certain localities, point out the necessity of a careful watch on the compass at all times. A table of deviations is as necessary after adjustment as before, and the error of the compass should be frequently found and the table corrected.

CHAPTER IX.

GENERAL EXAMPLES FOR EXERCISE.

EXAMPLE 1. In swinging ship in an open harbor (page 9, Case II) the following bearings were observed of a distant object; find the error of the compass in each case, the true bearing of the distant object being N. $41^{\circ} 12'$ W.

| Ship's Head. | Bearing of Object by Compass. | Error of Compass. |
|--------------|----------------------------------|---------------------|
| N. | N. $22^{\circ} 42'$ W. | $18^{\circ} 30'$ W. |
| NE. | N. $31^{\circ} 00'$ W. | $10^{\circ} 12'$ W. |
| E. | N. $31^{\circ} 48'$ W. | $9^{\circ} 24'$ W. |
| SE. | N. $25^{\circ} 30'$ W. | $15^{\circ} 42'$ W. |
| S. | N. $18^{\circ} 00'$ W. | $23^{\circ} 12'$ W. |

EXAMPLE 2. In swinging ship in a closed harbor (page 9, Case III) the following bearings were observed; find the deviation in each case. Bearings of the ship compass from the shore, N. $\frac{1}{4}$ W., N. by E. $\frac{1}{4}$ E., N. $\frac{3}{4}$ W. Corresponding bearings of shore compass from the ship, S. by E., SSW. $\frac{1}{4}$ W., S. $\frac{1}{4}$ W.
Ans. $\frac{3}{4}$ pt. E., 1 pt. W., 1 pt. W.

EXAMPLE 3. In swinging ship in a closed harbor (page 9, Case III) the following bearings were observed. Find the deviation in each case. Bearings of the ship compass from the shore, N. $\frac{1}{4}$ E., SW. by W., W. $\frac{1}{2}$ N. Corresponding bearings of shore compass from the ship, S. $\frac{1}{4}$ E., NE. $\frac{1}{4}$ E., E. $\frac{1}{4}$ N.

Ans. $\frac{1}{2}$ pt. E., $\frac{1}{2}$ pt. E., $\frac{3}{4}$ pt. E.

EXAMPLE 4. The ship on the way down the channel was stopped and the following bearings of two objects in line were taken for compass error (page 24). The true bearings of the objects in line on the chart was N. $12^{\circ} 30'$ W. Find the error of the compass in each case.

| Ship' Head. | The Line of Compass. | Error of Compass. |
|--------------------|------------------------|---------------------|
| N. 6° E. | N. $0^{\circ} 15'$ W. | $12^{\circ} 15'$ W. |
| N. 35° E. | N. $15^{\circ} 30'$ W. | $3^{\circ} 00'$ E. |
| N. 65° E. | N. $20^{\circ} 00'$ W. | $7^{\circ} 30'$ E. |
| S. 60° E. | N. $8^{\circ} 30'$ W. | $4^{\circ} 00'$ W. |
| S. 50° E. | N. $6^{\circ} 00'$ W. | $6^{\circ} 30'$ W. |

EXAMPLE 5. The bearing of a distant object by the ship's compass was N. 50° W., with the ship's head N. $78^{\circ} 45'$ E. What was the magnetic bearing of the distant object?

Ans. N. $42^{\circ} 30'$ W.

EXAMPLE 6. The compass course is ENE. or N. $67^{\circ} 30'$ E., and the deviation is $7^{\circ} 20'$ E. What is the magnetic course?

Ans. N. $74^{\circ} 50'$ E.

EXAMPLE 7. The compass course is SSW. and the deviation is $5^{\circ} 20'$ W. What is the magnetic course?

Ans. S. $17^{\circ} 10'$ W.

EXAMPLE 8. The compass course is NE., deviation 8° E., variation $9^{\circ} 30'$ E. What are the magnetic and true courses?

Ans. Magnetic, N. 53° E.; true, N. $62^{\circ} 30'$ E.

EXAMPLE 9. The compass course is NNE., deviation $5^{\circ} 40'$ E., variation 10° W. What are the magnetic and true courses?

Ans. Magnetic, N. $28^{\circ} 10'$ E.; true, N. $18^{\circ} 10'$ E.

EXAMPLE 10. The compass course is NW. by W.; wind NNE.; deviation $5^{\circ} 40'$ W.; leeway 1 pt.; and variation $8^{\circ} 45'$ E. What are the magnetic and true courses?

Ans. Magnetic, N. $73^{\circ} 10'$ W.; true, N. $64^{\circ} 25'$ W.

EXAMPLE 11. The true course is WNW.; variation $6^{\circ} 40'$ E.; deviation $4^{\circ} 10'$ W.; wind N.; leeway 2 pts. What are the magnetic and compass courses?

Ans. Magnetic, N. $74^{\circ} 10'$ W.; compass, N. $47^{\circ} 30'$ W.

EXAMPLE 12. The true course is N. $26^{\circ} 05'$ E.; variation $7^{\circ} 35'$ W.; wind E.; leeway 1 pt. What is magnetic course? Find from table what deviation to apply and then find the compass course.

Ans. Magnetic, N. $33^{\circ} 40'$ E.; deviation $6^{\circ} 09'$ E.; compass N. $38^{\circ} 46'$ E.

EXAMPLE 13. In latitude $50^{\circ} 13'$ N. the ship sailed the following true courses and distances. Find the course and distance made good. WSW. 51 miles; W. by N. 35 miles; S. by E. 45 miles; SW. by W. 55 miles; SSE. 41 miles.

Ans. S. 39° W.; distance 162 miles.

EXAMPLE 14. In latitude $49^{\circ} 53'$ N. and longitude $5^{\circ} 12'$ W. the ship sailed the following courses (true) and distances. Find the course and distance made good. Latitude and longitude in S. 3 pts. W. 14 miles; S. 7 pts. W. 31 miles; S. $2\frac{1}{4}$ pts. W. 20 miles; S. $1\frac{1}{2}$ pts. W. 20 miles; N. $3\frac{1}{4}$ pts. W. 26 miles; N. $\frac{1}{4}$ pt. E. 28 miles; S. $3\frac{1}{4}$ pts. W. 24 miles; N. 5 pts. W. 8 miles.

Ans. S. $78^{\circ} 36'$ W.; distance 93 miles; latitude $49^{\circ} 40'$ N.; longitude $7^{\circ} 33'$ W.

EXAMPLE 15. The sun and its image were brought together (page 38) when the following readings on the sextant were

made. Find the index error. On the arc $33^{\circ} 10'$; off the arc $31^{\circ} 10''$. *Ans.* $-1^{\circ} 00''$.

EXAMPLE 16. The sun and its image were brought together when the following readings on the sextant were made. Find the index error. On the arc $30^{\circ} 10'$; off the arc $35^{\circ} 00''$.

Ans. $+2^{\circ} 25''$.

EXAMPLE 17. Given the following readings of the sextant, find the index error. On the arc $35^{\circ} 50'$, $36^{\circ} 00''$, and $36^{\circ} 10''$; off the arc $27^{\circ} 20''$, $27^{\circ} 30''$, and $27^{\circ} 40''$. *Ans.* $-4^{\circ} 15''$.

EXAMPLE 18. The difference of longitude between two places is $98^{\circ} 41' 36''$. What is the difference in time?

Ans. 6 hrs. 34 min. 46.4 sec.

EXAMPLE 19. The difference of longitude between two places is $60^{\circ} 30' 24''$. What is the difference in time?

Ans. 4 hrs. 2 min. 1.6 sec.

EXAMPLE 20. One place is in longitude $125^{\circ} 16' 24''$ E., another in $143^{\circ} 18' 36''$ W. Find the difference in time between the two places. *Ans.* 6 hrs. 5 min. 40 sec.

EXAMPLE 21. The difference of longitude between two places is $73^{\circ} 1' 00''$. What is the difference in time?

Ans. 4 hrs. 52 m. 4 sec.

EXAMPLE 22. The difference in time between two places is 6 hrs. 0 min. 19.26 sec. What is the difference in longitude?

Ans. $90^{\circ} 4' 48''.9$.

EXAMPLE 23. When it is 2 hrs. 10 min. 15 sec. in the afternoon at A. it is six o'clock in the afternoon at B. What is the difference of longitude? *Ans.* $57^{\circ} 26' 15''$.

EXAMPLE 24. When it is 10 hrs. 30 min. A.M. at a place in west longitude, it is 5 hrs. 9 min. 10 sec. P.M. at one in east longitude. What number of degrees of longitude are the two places apart? *Ans.* $99^{\circ} 47' 30''$.

EXAMPLE 25. It is May 12th, 2 hrs. at ship, in longitude $17^{\circ} 25' 30''$ E.; the chronometer shows 50 min. past 12. What is the Greenwich date?

Ans. May 12th, 0 hrs. 50 min. 18 sec.

EXAMPLE 26. It is May 12th in longitude $120^{\circ} 13' 14''$ E.; the chronometer shows 9 hrs. 20 min. 10 sec. A.M. What is the time at the ship P.M.?

Ans. May 12th, 5 hrs. 21 min. 2.9 sec.

EXAMPLE 27. It is May 12th in longitude $120^{\circ} 13' 14''$ W.;

the chronometer shows 9 hrs. 20 m. 10 sec. A.M. What is the time at ship A.M.? *Ans.* May 11th, 13 hrs. 19 min. 17.1 sec.

EXAMPLE 28. Sept. 4th, 1890, at 5 hrs. 49 m. P.M., nearly, at ship, in longitude by D. R. $147^{\circ} 18' W.$, the chronometer showed 3 hrs. 35 min. 18 sec., and its error was 4 min. 18 sec. slow. What is the Greenwich date?

Ans. Sept. 4th, 15 hrs. 39 min. 36 sec.

EXAMPLE 29. June 10th, 1890, at 10 hrs. 18 min. 4 sec. A.M., nearly, at ship in longitude $47^{\circ} 18' 15'' E.$, the chronometer, which was fast 10 min. 14 sec. on April 15th and gaining daily 2.5 sec., showed 7 hrs. 21 min. 20 sec. What is the correct Greenwich date? *Ans.* June 9th, 19 hrs. 8 min. 48.5 sec.

EXAMPLE 30. Aug. 31st, about 8 A.M., the chronometer showed 0 hrs. 5 min. 30 sec., in longitude $61^{\circ} 10' 30'' W.$, the error of the chronometer 1 min. 55 sec. slow. Find the correct Greenwich time and date.

Ans. 0 hrs. 7 min. 25 sec.; August 31st.

EXAMPLE 31. At noon in latitude $30^{\circ} S.$ a watch was set right to mean time at ship, and by the following noon the ship sailed SW. true distance 120 miles. What is the error of watch on mean time at ship? *Ans.* 6 min. 32 sec. fast.

EXAMPLE 32. At 8 P.M. a watch is exactly right for mean time at ship; by 8 A.M. on the following morning the ship changed her longitude 72 miles to the eastward of her former position. How much must the watch be altered to set it to mean time at ship? *Ans.* Set ahead 4 min. 48 sec.

EXAMPLE 33. Jan. 17th, 1890, in longitude $59^{\circ} 40' E.$, the sun on the meridian. Find the declination.

Ans. $20^{\circ} 43' 42'' S.$

EXAMPLE 34. Jan. 5th, 1890, at 7 hrs. 40 min. 30 sec. P.M., in longitude $48^{\circ} W.$ Find the declination.

Ans. $22^{\circ} 31' 55''.2 S.$

EXAMPLE 35. July 23d, 1890, at 8 hrs. 20 min. 40 sec. A.M. in longitude $104^{\circ} 12' E.$ Find the declination.

Ans. $20^{\circ} 08' 18''.3 N.$

EXAMPLE 36. Sept. 20th, 1890, at 8 hrs. 4 min. A.M., in longitude $77^{\circ} 13' W.$ Find the declination.

Ans. $0^{\circ} 59' 49''.6 N.$

EXAMPLE 37. Feb. 14th, 1890, at 5 h. 30 m. 40 sec. P.M., in longitude $41^{\circ} 03' E.$ Find the declination.

Ans. $12^{\circ} 52' 39'' S.$

EXAMPLE 38. Dec. 24th, 1890, the Greenwich mean time is 17 h. 44 m. Find the equation of time. *Ans.* 0 m. 19 sec.

EXAMPLE 39. May 24th, 1890, at 4 h. 35 m. P.M., in longitude $91^{\circ} 30'$ E. Find the equation of time.

Ans. 3 m. 23 sec.

EXAMPLE 40. March 3d, 1890, at 8 h. 20 m. A.M., in longitude $169^{\circ} 40'$ W. Find the equation of time.

Ans. 12 m. 01 sec.

EXAMPLE 41. Oct. 11th, 1890, in longitude $159^{\circ} 30'$ E. the local mean time is 8 h. 3 m. 17 sec. A.M. What is the local apparent time? *Ans.* Oct. 10, 20 h. 16 m. 21 sec.

EXAMPLE 42. April 23d, 1890, A.M., in longitude $125^{\circ} 28' 15''$ W., the time by chronometer is 5 h. 27 m. 12 sec.; chronometer correction $- 8$ m. 12 sec. Find the local apparent time.

Ans. April 22d, 20 h. 58 m. 56 sec.

EXAMPLE 43. Oct. 3d, 1888, in longitude $67^{\circ} 30'$ W. the observed meridian altitude of the sun's lower limb was $40^{\circ} 23' 50''$ bearing north; index error $+ 1' 30''$; height of the eye 18 feet. Find the latitude. *Ans.* $53^{\circ} 42' 14''$ S.

EXAMPLE 44. March 8th, 1890, in longitude $15^{\circ} 15'$ E. the observed meridian altitude of the sun's lower limb was $83^{\circ} 58' 16''$ bearing north; index error $+ 3' 15''$; height of the eye 22 feet. Find the latitude. *Ans.* $10^{\circ} 36' 08''$ S.

EXAMPLE 45. May 1st, 1890, in longitude $30^{\circ} 30'$ W. the observed meridian altitude of the sun's lower limb was $84^{\circ} 59'$ bearing S.; index error $- 2' 20''$; height of the eye 18 feet. Find the latitude. *Ans.* $20^{\circ} 01' 03''$ N.

EXAMPLE 46. July 10th, 1890, in longitude 100° E., the observed meridian altitude of the sun's lower limb was $44^{\circ} 43' 26''$ bearing N.; index error 0; height of the eye 20 feet. Find the latitude. *Ans.* $22^{\circ} 49' 43''$ S.

EXAMPLE 47. Sept. 23d, 1890, in longitude 45° W., the observed meridian altitude of the sun's lower limb was $47^{\circ} 10' 30''$ bearing S.; index error $- 2' 40''$; height of the eye 18 feet. Find the latitude. *Ans.* $42^{\circ} 30' 13''$ N.

EXAMPLE 48. About 8 A.M., Sept. 30th, 1890, in latitude $30^{\circ} 10'$ N. and west longitude, the observed altitude of the sun's lower limb was $29^{\circ} 51' 50''$; index error $+ 2' 10''$; height of the eye 18 feet; watch time of observation 8 h. 20 m.; slow of chronometer time 1 h. 24 m. 44 sec.

Chronometer correction on Sept. 20th was $+1$ h. 15 m. 0 sec., with a losing rate of 4.5 sec. Find the longitude.

Ans. $40^{\circ} 05' 30''$ W.

EXAMPLE 49. April 23d, A.M., 1890, in latitude $44^{\circ} 59'$ S. and west longitude, the observed altitude of the sun's lower limb was $19^{\circ} 9'$; index error $+1' 58''$; height of the eye 14 feet. The time by chronometer 5 h. 27 m. 12 sec.; chronometer correction -8 m. 12 sec. Find the longitude.

Ans. $125^{\circ} 23' 45''$ W.

EXAMPLE 50. Jan. 20th, 1890, P.M., in latitude $50^{\circ} 42'$ S. and east longitude, the observed altitude of the sun's lower limb was $17^{\circ} 10'$; index-correction $-2' 13''$; height of the eye 18 feet; watch time of observation 6 h. 46 m. 28 sec.; slow of chronometer time 5 h. 36 m. 15 sec.; chronometer correction $+29$ sec. Find the longitude.

Ans. $96^{\circ} 06'$ E.

EXAMPLE 51. An altitude of the sun was taken one forenoon and worked out with assumed latitudes of $35^{\circ} 30'$ N. and $35^{\circ} 50'$ N., respectively. The first gave a longitude of $14^{\circ} 24'$ W. and the second of $14^{\circ} 05'$ W. What is the direction of the line of position on the chart?

Ans. N. 38° E.

EXAMPLE 52. An observation taken one forenoon and worked with assumed latitudes of 51° N. and 52° N., respectively. The first gave a longitude of $15^{\circ} 46'$ W. and the second of $11^{\circ} 51'$ W. Sun bore per compass at the time S. $28^{\circ} 30'$ E. Find the true bearing of the sun and error of the compass.

Ans. True bearing S. 22 E. Error of compass $5^{\circ} 30'$ E.

EXAMPLE 53. An observation taken one forenoon and worked with assumed latitudes of $50^{\circ} 31'$ N. and $50^{\circ} 40'$ N., respectively. The first gave a longitude of $15^{\circ} 30'$ W. and the second $15^{\circ} 23'$ W. Sun bore per compass at the time S. 55° E. Find the true bearing and error of the compass.

Ans. True bearing S. 64 E. Error of compass 9° W.

EXAMPLE 54. Sept. 23d, 1890, in latitude $40^{\circ} 09' 15''$ S., longitude $52^{\circ} 30'$ E., about 6 P.M., the observed bearing of the sun at setting was N. $60^{\circ} 10'$ W. Find the error of the compass.

Ans. $30^{\circ} 03'$ W.

EXAMPLE 55. June 5th, 1891, in latitude $11^{\circ} 29'$ N., longitude 30° W., about 6 h. 10 m. A.M., the observed bearing of the sun at rising was N. 59° E. Find the error of the compass.

Ans. $7^{\circ} 59'$ E.

EXAMPLE 56. Nov. 27th, 1891, in latitude $40^{\circ} 27' N.$, longitude $20^{\circ} 07' W.$, about 4 h. 43 m. P.M., the observed bearing of the sun at setting was $S. 73^{\circ} W.$ Find the error of the compass. *Ans.* $11^{\circ} 20' 34'' W.$

EXAMPLE 57. Sept. 24th, 1890, at 3 h. 10 m. P.M., in latitude $10^{\circ} 15' N.$ and longitude $168^{\circ} E.$, the observed altitude of the sun's lower limb was $39^{\circ} 28'$; index error $+ 1' 15''$; height of the eye 18 feet. The sun bore at the time by compass $S. 84^{\circ} 20' W.$ Find the error of the compass. *Ans.* $3^{\circ} 30' W.$

CHAPTER X.

ERROR OF THE COMPASS.

THE error to which the compass is constantly subjected, being compounded of variation and deviation, must necessarily be an ever-changing quantity. In some localities the variation is nearly stationary, but in others there is an annual change more than likely not corrected on the chart, and there are parts of the world where a trifling change in the position of the ship means a comparatively large change in the amount of the variation. The deviation table, as constructed in port, is liable to many changes after the vessel goes to sea. It is not uncommon, after a straight run for several days, to find the deviation change fully half a degree for every degree of alteration in the compass course, and in some instances the compass will jump a point or two without an alteration of the ship's head. This is due to a change of heel, loose iron placed near the compass, boat davits turned in that were before swung out, or the many causes mentioned in the first chapter. From this it will be seen nothing but constant watchfulness of the behavior of the compass can ensure safety; to this end the error of the compass is frequently determined.

The compass bearing of the sun is taken and the true bearing for the same instant is calculated, the difference between

the two being the error, and is marked E. or W. according as the compass bearing falls to the left or right of the true bearing.

Should the error be found to change much, it would be advisable to head the vessel so as to get the error on every few points in that half of the compass most likely to be used during the next few days, and especially so if approaching land.

There are three ways of finding the true bearing of the sun at sea: *by lines of position*, *by an amplitude*, and *by an observed altitude*.

By Line of Position. The most simple method of determining the true bearing of the sun is by the lines of position plotted on the chart and sufficiently accurate for all purposes in navigation.

It has been said the sun always bears at right angles to the line of position: so at any point on the line of position draw a perpendicular and refer it to the true compass on the chart. The direction of this perpendicular is the true bearing of the sun; comparing this with the compass bearing at the time of taking the observation from which the line of position was derived, will give the error.

By an Amplitude. When the sun is rising or setting, its distance from the E. or W. points of the horizon is called its amplitude.

As refraction causes the sun to appear higher than it actually is, and its effect is greatest when the sun is in the horizon, being about equal to the apparent diameter of the sun, the bearing should not be taken for an amplitude when the centre appears in the horizon, but when it is a little more than its diameter plus the dip above the horizon.

Take from Table III the declination of the sun for the Greenwich date and correct it for the Greenwich time. Add together the sine of the declination and the secant of the latitude; from Table V the sum (rejecting 10 in the index) is the sine of the true amplitude, marked E. at rising and W. at setting, and N. or S. as the declination is N. or S. Should the compass amplitude and the true be of the same name, their difference will be the error; if of different names, their sum will be the error for the course the ship is heading. If this error be to the right of the variation on the chart, the deviation will be easterly; if to the left, westerly.

EXAMPLE.

At sea Nov. 27, 1887, in latitude $40^{\circ} 27' N.$, longitude $20^{\circ} 07' W.$, about $4^h 43^m$ P.M., the observed bearing of the sun at setting was $W. 17^{\circ} S.$

L. M. T. $4^h 43^m$ P.M. Dec. $21^{\circ} 08' S.$

Long. $1 \ 20 \ W.$ Corr. $+ \ 2.42$

G. M. T. $6 \ 03$ P.M. True Dec. $21 \cdot 10' 42'' S.$ sin 9.55783

Latitude $40 \ 27 \ N.$ sec 0.11863

sin 9.67646

Diff. $1 \ hr. \ 27''$

True amplitude $W. \ 28^{\circ} 20' S.$

G. M. T. 6^h

Compass " $W. \ 17^{\circ} S.$

Corr. $+ \ 162$ or $2' 42''$

Error $11 \ 20 \ W.$

If the variation by chart was $10^{\circ} W.$ the deviation would be $1^{\circ} 20' W.$ for the point of the ship's head.

By an Observed Altitude. At the time of taking the altitude for time take also the bearing of the sun by compass, and note the heading of the ship; also the heel, and whether to port or starboard.

The preparation of the data in this problem is the same as that for finding the time by observation, and it is usual to combine the two. To find the true bearing, add together the true altitude, latitude, and the polar distance; take the difference between the half sum and the polar distance, and note the remainder. Then add together the secant of the altitude, secant of the latitude (rejecting 10 in each index), cosine of the half sum, and the cosine of the remainder; half the sum of the four quantities will be the cosine of half the true bearing, which, being doubled, will give the true bearing reckoned from the north in north latitude and the south in south latitude.

EXAMPLES.

We will take the first example used in finding the time, and combine the two problems to illustrate the form used in practice.

PREPARATION OF DATA.

W. Time $8^h 51^m 57^s$ A.M.

Obs. Alt. $22^{\circ} 29' 20''$

C. — W. $4 \ 54 \ 15$

S. D. $+ \ 16 \ 00$

I. C. $+ \ 2 \ 45$

| | |
|------------------------|--------------------|
| C. Time 1 46 12 | Ref. — 2 20 |
| C. Corr. — 2 12 | Dip — 4 02 |
| | Par. + 8 |
| Gr. M. T. 1 44 00 P.M. | True Alt. 22 41 51 |
| Dec. 17° 00' 00" S. | Diff. 1 hr. 43" |
| Corr. + 1 13 | G. M. T. 1.7 |
| True Dec. 17 01 13 S. | Corr. 731 |
| 90 00 00 | or + 1' 13" |
| Pol. Dis. 107 01 13 | |

SOLUTION.

| | | |
|---------------------|---------------|-------------|
| Alt. 22° 41' 51" | | sec 0.03500 |
| Lat. 35 00 00 | sec 0.08664 | sec 0.08664 |
| Pol. Dis. 107 01 13 | cosec 0.01945 | |
| Sum 164 43 04 | | |
| Half Sum 82 21 32 | cos 9.12374 | cos 9.12374 |
| 1st Rem. 59 39 41 | sin 9.93604 | |
| 2d Rem. 24 39 41 | | cos 9.95846 |
| | 2)19.16587 | 2(19.20384 |
| | sin 9.58293 | cos 9.60192 |

Local App. Time 8^h 59^m 58^s A.M. Half of true bearing 66° 26'
2

| | |
|---|-----------------------------|
| | True bearing N. 132° 52' E. |
| Local App. Time 8 ^h 59 ^m 58 ^s A.M. | True bearing N. 132° 52' E. |
| Equation of Time—16 01 | Com. bearing N. 130 30 E. |
| Local M. Time 8 43 57 A.M. | Com. Error 2 22 E. |
| Gr. M. T. 1 44 00 P.M. | |
| Diff. Time 5 00 03 | |
| or | |
| Longitude 75° 00' 45" W. | |

It will be seen from the above example that as it requires very little more work in the solution of the problem for time to obtain the compass error, it is always best to take the bearing of the sun by compass at the same instant the altitude is taken for time and combine the two, as shown in examples.

On April 3, 1888, in the forenoon, in latitude 29° 42' 30" S. and east longitude, the observed altitude of the sun's lower

limb was $22^{\circ} 41' 30''$; bearing per compass S. 89° E.; index correction $-2' 30''$; height of the eye 24 feet. Watch time of observation $8^h 06^m 20^s.5$; slow of chronometer time $8^h 08^m 14^s$; chronometer correction $-6^m 19^s$. Find the longitude and error of the compass.

PREPARATION OF DATA.

| | |
|--------------------------------|---------------------------------|
| W. Time $8^h 06^m 20^s.5$ A.M. | Obs. Alt. $22^{\circ} 41' 30''$ |
| C. — W. $8 \ 08 \ 14$ | S. D. $+ \ 16 \ 00$ |
| | I. C. $- \ 2 \ 30$ |
| C. Time $4 \ 14 \ 34.5$ A.M. | Ref. $- \ 2 \ 19$ |
| C. Corr. $- \ 6 \ 19$ | Dip $- \ 4 \ 48$ |
| | Par. $+ \ 08$ |
| G. M. T. $2d \ 16 \ 08 \ 15.5$ | |
| or | True Alt. $22 \ 48 \ 01$ |
| 3d $-7^h.86$ | |
| Dec. $5^{\circ} 35' 00''$ N. | Hr. Diff. $57''$ |
| Corr. $-7 \ 28$ | G. M. T. -7.86 |
| True Dec. $5 \ 27 \ 32$ N. | Corr. 448.02 |
| $90 \ 00 \ 00$ | or |
| | $-7' 28'$ |
| Pol. Dist. $95 \ 27 \ 32$ | |

SOLUTION.

| | | |
|--------------------------------------|---------------|--------------|
| Alt. $22^{\circ} 48' 01''$ | | sec 0.03533 |
| Lat. $29 \ 42 \ 30$ | sec 0.06120 | sec 0.06120 |
| Pol. Dist. $95 \ 27 \ 32$ | cosec 0.00198 | |
| Sum $147 \ 58 \ 03$ | | |
| Half Sum $73 \ 59 \ 01$ | cos 9.44077 | cos 9.44077 |
| 1st Rem. $51 \ 11 \ 00$ | sin 9.89162 | |
| 2d Rem. $21 \ 28 \ 31$ | | cos 9.96875 |
| | $2)19.39557$ | $2)19.50605$ |
| | sin 9.69778 | cos 9.75302 |
| Local App. Time $8^h 00^m 43^s$ A.M. | | |
| Equation Time $+ \ 3 \ 15$ | | |
| Local M. Time $8 \ 03 \ 58$ A.M. | | |
| Gr. M. Time $4 \ 08 \ 15.5$ A.M. | | |
| Diff. Time $3 \ 55 \ 42.5$ | | |
| Longitude $58^{\circ} 55' 37''$ E. | | |

Eq. Time Table, IV., $+3^m 10^s$ Half of true bearing $55^\circ 30' 37''$

Daily Variation 18^s 2

Correction, Table IVa, 5 _____

_____ True bearing S. 111 01 14 E.

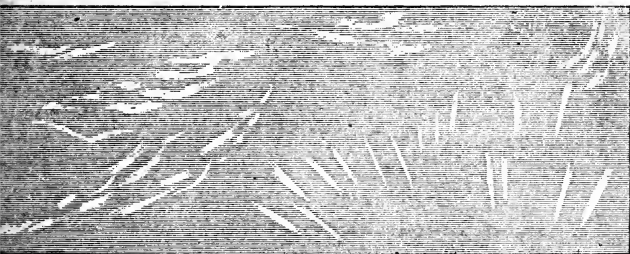
Equation of Time $+ 3 15$ Compass bearing S. 89 E.

Compass error 22 01 14 W.

CHAPTER XI.

CAUSES THAT AFFECT NAVIGATION AT SEA.

Clouds. The general appearance of the clouds tends greatly to assist the navigator in foretelling the state of the weather ; and according to their form they are divided into three classes, called *cirrus*, *cumulus*, and *stratus*. There are four other forms in which these are blended, known as *cirro-cumulus*, *cirro-stratus*, *cumulo-stratus*, and *nimbus*. Though it is easy to distinguish the first three classes when their forms are well characterized, it is often very difficult to accurately designate the blended forms, as some observers will call *cirro-stratus* what others would designate *cumulo-stratus*.



CIRRUS.

The **Cirrus** are composed of thin filaments, resembling a brush, and at times woolly hair or slender network. These

are the most elevated clouds, and their appearance often precedes a change of weather. In summer they announce rain ; in winter, frost or snow.

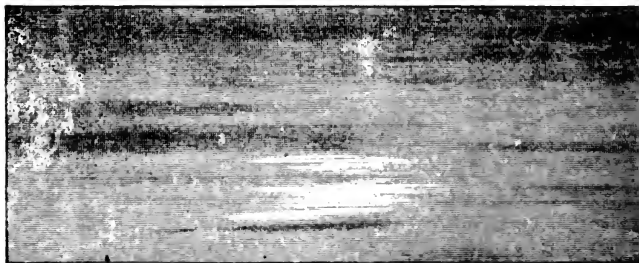
The **Cumulus** appear in the form of a hemisphere resting on a horizontal base ; sometimes these hemispheres rest one



CUMULUS.

upon the other, and form those great clouds which accumulate on the horizon, and look like distant mountains covered with snow. They predict warm southerly winds.

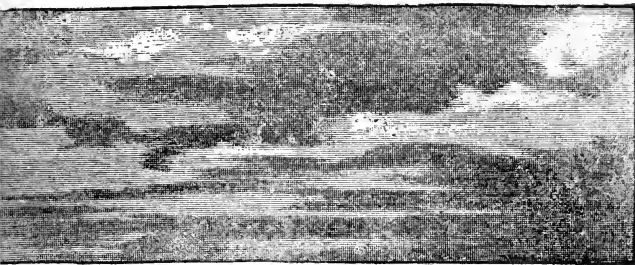
The **Stratus** are the horizontal bands, which form fre-



STRATUS.

quently at sunset, and, combining with the other two forms, indicate what might be expected in the state of the weather—moisture.

Cirro-cumulus appear as a number of little round, fleecy clouds, and foretell heat.



CIRRO-CUMULUS.

Cirro-stratus are composed of little bands of filaments, more compacted than those of the cirrus, and not so high, of a grayish tint, and hardly ever fail to form rain.



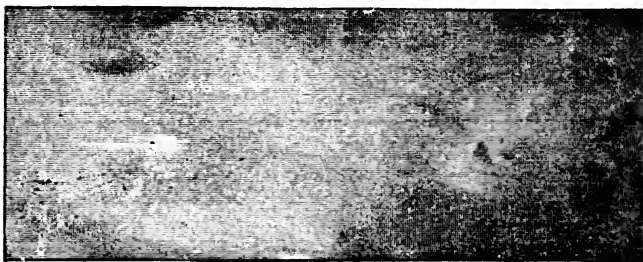
CIRRO-STRATUS.

Cumulo-stratus are formed from the cumulus clouds becoming more dense, or heaped together. If they appear in the morning, rainfall may occur, but will cease near noon as a rule; and when they form about noon, rain may follow, but will cease towards evening.



CUMULO-STRATUS.

Nimbus are the dense black clouds with gray-fringed edges, and are variously composed of the other forms, mainly



NIMBUS.

of the compacted cumulus, and are always accompanied by rain, wind, or storms.

Storms and Currents are most uncertain causes that endanger the position of the ship at sea, and should, be carefully guarded against.

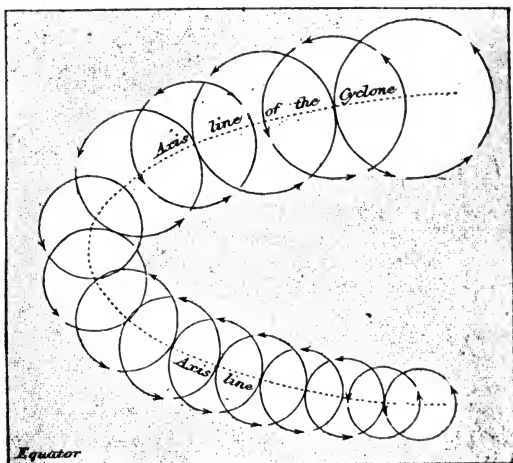
Storms. Wind is air in motion caused by difference of temperature, and the direction is designated by the point of the compass from which it blows. When this difference of temperature is great the motion of the wind is exceedingly heightened, and in some cases in the region of a mountainous

coast it rushes suddenly down with almost irresistible force. The wind blowing in great violence in one direction is called a **straight-line gale**. The most severe gales met with, however, at sea, are commonly known as **revolving storms**, variously called hurricanes, typhoons, and cyclones, according to the locality in which they blow. These revolving storms have two motions—one in a circle like a whirlwind, and the other a forward movement on a curved track. Knowing these two movements, the problem then to be considered in relation to the safety of the ship is: 1st. Ascertain the character of the storm and locate its centre. 2d. Determine which half of the storm-centre the ship is in. 3d. The direction in which the storm is moving. 4th. What to do with the ship to escape the centre, or take advantage of the fair winds.

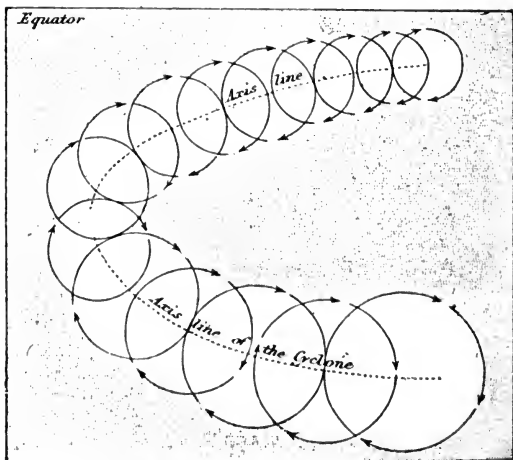
The **character** of the storm is indicated by the weight of the atmosphere, and as heat and moisture are the principal causes of the variation in the weight of the atmosphere, it follows that the temperature and degree of moisture should be known at the time of observation. The **barometer** is an instrument for measuring the weight, the **thermometer** gives the temperature, and the **hygrometer** the degree of moisture in the air.

The Barometer. There are various forms of the barometer, but the one best suited for observations is the mercurial, consisting of a brass tube about 33 inches in length, the extremity of which is inserted into a small cistern. In order to maintain the mercury in the cistern at the same level, the cistern is constructed partly of leather. By means of a screw at the bottom, the surface of the mercury in the cistern may be so adjusted as to have it always at the place from which the scale commences. The upper part of the tube is cut through so as to expose the column of mercury. Attached to one side of this opening is a scale graduated in inches and parts; and inside this slides a small tube carrying a vernier, which is moved up or down by a small thumb-screw. A thermometer is attached to the barometer to indicate the temperature of the mercury in the cistern. When suspended for use the barometer should hang freely in a vertical position, exposed in the shade where no local heat or cold is liable to affect it

[NORTHERN HEMISPHERE]



[SOUTHERN HEMISPHERE]



THE TWO MOTIONS OF A CYCLONE.

Whenever opportunity offers, the barometer should be compared with a standard, and the corrections noted.

A want of absolute information as to the mean level of the mercury will not prevent advantage being taken of barometrical observations in practical navigation; yet it is best to know the mean level at the position of the observer. Monthly charts issued by the Hydrographic Office of the Navy Department, a branch office of which is located at all large maritime cities in the United States, gives the mean level of the barometer at a great many positions in the Atlantic and a few in the Pacific Ocean. In the absence of these charts, the following table, according to Maury, is most reliable for each parallel of latitude in the North Atlantic, from the equator to seventy degrees North.

| North latitudes. | Height of barometer. | North latitudes. | Height of barometer. | North latitudes. | Height of barometer. |
|------------------|----------------------|------------------|----------------------|------------------|----------------------|
| | Inches. | ° | Inches. | ° | Inches. |
| Equator. | 29.918 | 25 | 30.119 | 50 | 30.001 |
| 5° | 29.910 | 30 | 30.182 | 55 | 29.989 |
| 10 | 29.941 | 35 | 30.162 | 60 | 29.878 |
| 15 | 29.989 | 40 | 30.111 | 65 | 29.839 |
| 20 | 30.052 | 45 | 30.052 | 70 | 29.800 |

The Thermometer is an instrument founded on the principle that most bodies expand by heat and contract by cold. Its construction differs from the barometer in having the tube closed at both ends. There are three descriptions of thermometers in common use, constructed on the same principle, but differing in the division of their respective scales. Fahrenheit's thermometer is the one generally used in America, and is marked from melting ice at 32 degrees to boiling water at 212 degrees, the interval being divided into 180 equal parts. The same graduation is extended downwards to zero and below. The bulb should be kept dry, and exposed in the shade to the open air.

The Hygrometer is simply a thermometer with the bulb wrapped in a little muslin bag, or a kind of wick reaching from it into a small cistern of water from one to three inches away. The difference in the reading of the wet and dry thermometers gives the evaporating power of the air, upon

which depends the amount of moisture present. The thermometer and hygrometer should be enclosed in a case having a lattice front.

Approach of a Storm. The indications of the approach of a storm are : a restless state of the barometer ; a hard gray sky or one having a greenish tint ; a blood-red or bright-yellow sunset ; a heavy swell, and a thick, lurid appearance of the sky, in connection with a general threatening condition of the weather. No great storm ever sets in with a steady rising barometer, and it will blow a storm whenever the barometer rises or falls suddenly. The barometer will not rise much in front of a slowly moving storm, but the banking up of air on the border in front of a rapidly moving storm will often cause it to rise suddenly. A very rapid fall of the barometer after fairly entering the storm may be regarded as evidence of a very violent storm of small diameter, while a gradual fall would indicate the contrary. In the North Atlantic, anywhere between the equator and 30 degrees north latitude, when the barometer is observed to fall at the rate of .02 of an inch per hour and to reach a point from .2 to .3 below the mean level, precautions should be taken against the approaching storm. Gales will last a longer or shorter time, and are foretold twelve hours at least and sometimes twenty-four hours in advance, according as the rise or fall of the barometer is more or less rapid. A northerly wind will produce a high or rising barometer, and a southerly wind a low or falling barometer ; hence, the barometer being very high, with northerly winds, a sudden fall accompanied by rise of the thermometer indicates that the wind will back with great force to the southward. Should the barometer be very low, a sudden rise with a falling thermometer predicts a change of wind from the SW. to the NW. and a northerly gale. In winter a sudden fall of the barometer and the thermometer towards the freezing-point indicates snow. Off the coast of the United States the region traversed by the Gulf Stream is remarkable for its high temperature and for squally and uncertain weather, especially in winter. When the winds from W. to SW. blow a gale the heat of the atmosphere reaches its extreme, while beyond the northern and eastern limits of the storm is extremely cold. Should a storm be blowing from the NE

and the barometer begin to fall with a rise of the thermometer, the wind will haul to the E. and SE.; but should the barometer suddenly rise more, with a falling thermometer, the wind is liable to shift suddenly and with great force to the NW., and come out clear and cold.

To Locate the Centre. When facing the wind the centre of the storm will bear eight points to the right in the northern or eight points to the left in the southern latitudes; because in the northern portion of the globe the wind within the storm revolves from the right to left or left-handed, and in the southern part the wind revolves from the left to right or right-handed. Hence, when north of the equator, at the west point of the storm-circle the wind is north and the centre bears east; and south of the equator, at the west point of the storm-circle the wind is south and the centre bears east. If the barometer falls at the rate of .03 of an inch per hour and gets from .4 to .5 below the mean level, the indication is that the centre of the storm is about two hundred miles off; with an hourly fall of .05 to a point .78 of an inch below the mean level, the vessel may be considered about one hundred miles off. With a fall of .09 to 1.5 per hour below the mean level, the vessel will be very close to the centre, if not in it. When the barometer begins to rise again, at first very quickly and afterward with a more moderate movement, the centre of the storm will be travelling away from the ship, and the danger is over.

Semicircles of the Storm. The storm-circle is divided into two equal parts by the storm track, and that portion on the right side looking in the direction of the track is termed the right semicircle, while that portion to the left is called the left semicircle.

In the right semicircle the change of wind will be to the right, and in the left semicircle the change will be to the left; therefore the first change of wind will indicate which half of the storm-circle the ship is in. Should the vessel be directly on the track of the storm or near it on either side there would be no perceptible change of wind, but a falling barometer would indicate the vessel was in front and a rising barometer in rear of the storm.

Direction of Storm Track. The approximate direction in which the storm is moving may be found by plotting on

the chart the position of the ship and centre of the storm on two or more bearings as the wind changes, using the distance of the centre by barometer, and keeping an accurate account of the distance made by the ship in the interval.

To Avoid the Centre. Having ascertained the above data, it becomes necessary now to determine what to do with the ship to escape the centre or place the vessel in a position to incur the minimum amount of danger or take advantage of the fair winds as the case may be.

The rules to be observed are given in the following storm-cards.



Currents. A current is a progressive motion of the water, occasioned by prevailing winds and differences of temperature and density, and causes all floating bodies to move in the direction of its set. The *set* is that point of the compass towards

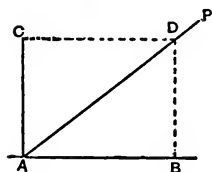
which the waters run, and its *drift* is the rate it runs per hour. The effect of a constant or prevalent wind produces what is called a *drift current*, is generally shallow, and hardly ever exceeds half a mile per hour with a good breeze. The accumulation of the drift into a collective mass by the intervention of some obstacle produces what is called a *stream current*. It takes the direction imposed by the obstacle, and in many cases is a deep, powerful stream, not unlike a river in the ocean. These two forms of current cause a constant circulation to be going on in the waters of the globe, and are usually marked on



the charts with the set and drift given. As they are liable to vary in both speed and direction and temporary eddies not marked on the chart, their existence and influence may be found by a comparison between the position by dead-reckon-

ing and that by observation, corroborated by a change in the temperature or density of the water.

Current Sailing. With the set and drift of a current known, it can be allowed for in the following manner: Draw a line



AB on the chart in the direction of the set, and from the position of the ship A lay off on this line AB equal to the hourly drift, taking the measurement from any convenient scale, say an inch to the mile. With the same scale at A erect a perpendicular to AB , and lay off on this perpendicular

AC equal to the vessel's speed per hour; draw CD parallel to AB , and BD parallel to AC . In order then to make good the intended course AD , and keep the objective point P constantly on the same line of bearing, the vessel will have to steer in the direction of AC . The scale on the chart will be found too small to give a working size to the figure; however, it can be used by multiplying the drift of the current and the rate of the vessel by some convenient number.

Icebergs. The currents from the polar regions bring with them great quantities of floating ice, and the presence of these icebergs constitutes a very serious danger to navigation. The latitudes in which these floating islands are to be met with are generally marked on the chart, and when in those regions no precaution should be neglected to discover them before the danger becomes too great.

A large iceberg will denote its presence, even on the darkest night, by a sort of whiteness or halo known as "*ice blink*." The echo of a gun or steam-whistle is liable to detect the presence of an iceberg; and should one be to windward, the temperature of the air would indicate its proximity. The temperature of the water cannot be relied upon as a means of detecting the presence of ice.

Should a berg be discovered, always endeavor to pass on the weather side on account of the loose pieces drifting more rapidly.

CHAPTER XII.

AIDS TO NAVIGATION.

WHEN the vessel on her course leaves the deep water and comes upon soundings, the fact is at once known by a change in the temperature of the water and the blue appearance of the sea changing to a decided green color. The evidence of approaching shore is noted in the presence of birds, floating objects, nature of the swell of the sea, and the sense of smell. The land is first seen in an outline resembling a thick cloud, but which can hardly be mistaken.

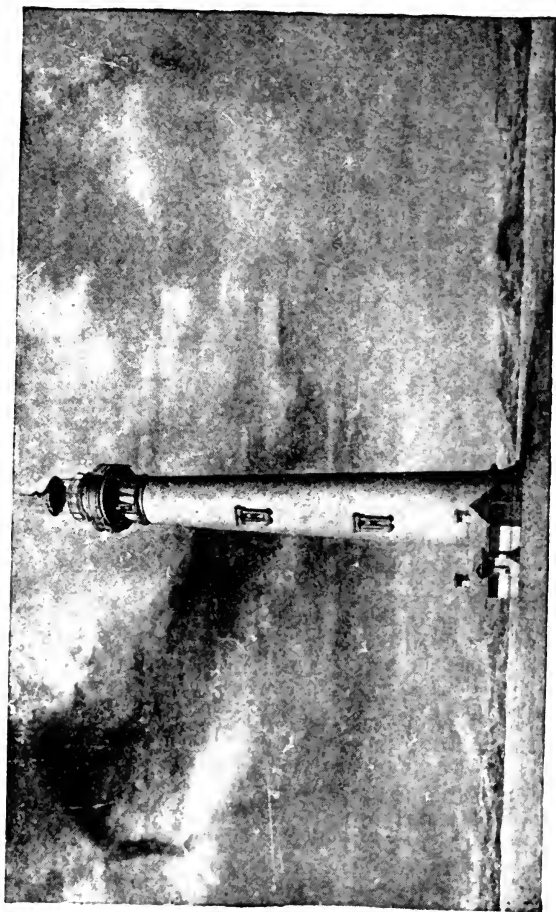
In making the proper point or working the way into port it is advantageous to observe the nature of the shore, complexion of the land, and configuration of the coast-lines, also by noting an isolated tree, church spire, windmill or prominent mountain.

In addition to these, all maritime countries have established a well-concerted series of landmarks as aids to navigation, such as light-houses, light-vessels, buoys, beacons, and fog-signals.

Light-houses. The light-house is not only a house or tower especially adapted for showing a light at night, but serves as a landmark by day. They are sufficiently diversified by different characteristics to properly define their respective positions.

As we approach the shore from seaward the most salient points of the coast-line are marked by first-class light-houses. These are located near each other, that one or more of them may be observed except in dense fog and thus the vessel avoid any danger from the obstructions they mark, and the navigator be enabled to correct any errors in his estimated position.

Secondary capes, reefs, etc., to which it is prudent to give a good offing, are marked by second- and third-class light-houses, whose light has a range regulated by what is considered a safe distance in which to navigate the vessel. During thick weather



SEA-COAST LIGHT-HOUSE AT CURRITUCK BEACH, NORTH CAROLINA.

the range of the first-class lights is greatly diminished in power and extent when those of the second class assist to fill up the vacancy thus caused in the primary illumination. Lights of these classes are also placed to mark the mouths of rivers and the entrance to ports only accessible by narrow channels, and to point out the exact course which should be steered.

Near the port or anchorage a small harbor light is placed upon one or each of the banks, piers, or breakwater as a guide to a good berth. Many of these small lights belonging to tidal harbors are not exhibited until the tide has reached a certain determined height.

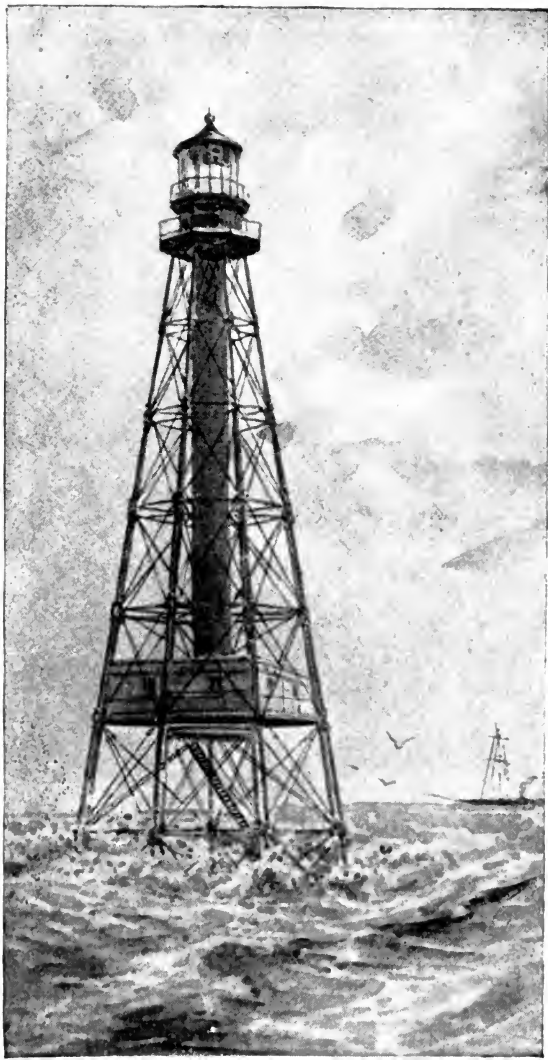
Order of Lights. In the United States the lights are divided into six orders. Lights of the first order are those established to give warning of the approach to land; those of the second, to mark the secondary points or headlands along the sea coast and the approach to bays and sounds; third-order, lights are used in bays that are of considerable width and intricacy, and for the coast of lakes; lights of the fourth, fifth, and sixth orders mark the most prominent points, headlands, or shoals in the long bays, sounds, or obstructions in rivers, and piers or wharves.

Character of Lights. In addition to the division of lights according to their position for illumination, provision is made for their easy distinction so as to not mislead by a close resemblance of one to the other. To this end lights are divided into several distinctive characters—the fixed, revolving, flash or intermittent, and double light on one or two towers.

The Fixed Light is one which exhibits a regular and steady appearance, and is not subject to any change.

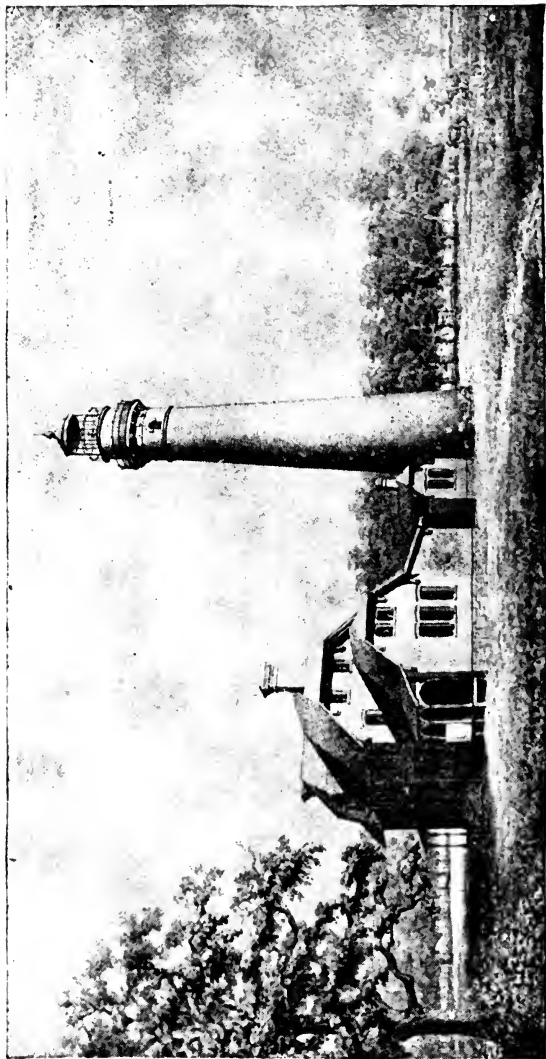
The Revolving Light gradually increases to a maximum and diminishes to a minimum until wholly extinguished at equal intervals of half a minute, one, two, or three minutes, and sometimes thrice a minute. It is produced by the revolution of a three- or four-sided frame having large reflectors grouped on each side, with their axes parallel.

The revolving light is subdivided into other classes, such as revolving white, revolving red and white, revolving red with two whites, or revolving white with two reds, obtained by the revolution of a frame whose sides present red and white lights in succession.





BUG LIGHT.



LAKE-COAST LIGHT-HOUSE AT GROSSE POINTE.

The Flash or Intermittent Light is one in which the ray suddenly appears, remains visible for a moment, and afterwards is again suddenly eclipsed for a brief interval. This is due to the perpendicular motion of circular shades in front of the reflector by which the light is alternately revealed and hidden. This light and the revolving light are sometimes combined to form the revolving flash light.

The Double Lights are seldom used except where a leading line is needed as a guide for taking some narrow channel or avoiding some danger. They are generally exhibited from two towers, one of which is higher than the other, and produce marked characteristic distinction or serve as a range to avoid danger. In the first case the distance between the lights is such as to prevent the two being blended into or supposed to be one light within the limits of their ranges. In the second case they are so arranged they will be seen to separate the moment of departure from the straight range line they are placed to mark. Frequently a very small arc is illuminated by one light which can be seen before encountering danger.

Colored Lights. Another means of distinguishing the various lights is in their color: some are red, with an intense ruddy-like splendor; others white, and some blue or green. However, colored lights should be observed with caution, as the use of coloring matter reduces in great proportions the intensity of the light; and the atmospheric conditions sometimes determine the color, which may lead to mistake as to the real color of the light. It has been observed that during foggy weather white lights become of a reddish color or tinge; green appears to approach in color or become white; and blue lights are not visible or change to so pale a violet tint as to be mistaken for white. But if there be two lights of different color, such as red and white, one becomes intensely red and the other a red tinge, both preserving their distinctive character. If green were in place of red, the two lights would appear to be red and white without a marked difference in color. Some heavy fogs, however, allow all the luminous rays to pass through them equally without coloring them, and only have the effect of diminishing their intensity. With equal intensity, the red light will be seen farther than the white light; but if the two are used, the white light will cease to be visible before the red light.

The electric light possesses a great distinction of color, but very little superiority in penetrating power in thick weather, and at any time is blinding, or its distance hard to ascertain.

Range of Lights. The distance at which a light may be seen depends upon its intensity and height above the sea or its luminous and geographical range. The luminous range de-

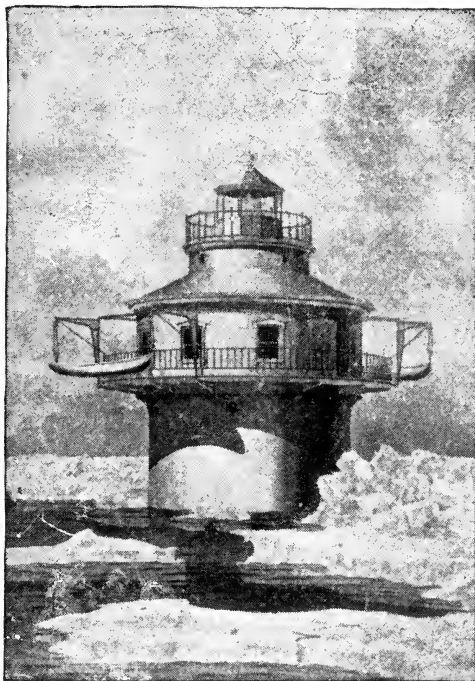


CRAIGHILL'S CHANNEL RANGE LIGHTS. —HIGH LIGHT.

pends upon the state of the atmosphere and the acuteness of the eye of the observer.

The geographical range depends upon the height above the level of the sea, upon the curvature of that part of the earth's surface at which it is placed, and upon the value of atmospheric refraction.

In the United States the heights of all light-houses are given in the lists and nautical books for mean low-water, together with range corresponding to different heights above the level of the sea both for the focal point and the eye of the observer. In some countries the tables are made out with reference to the level of the highest water.



CRAIGHILL'S CHANNEL RANGE LIGHTS.—LOW LIGHT.

By a reference to the chart, light list, and sailing directions a minute description and sketch of all light-houses will be found, their position accurately noted, the character and brilliancy of the light, the order or class, bearings on which the light is visible or obscured, height of the centre of the lantern above the high-water level or mean low tide ; height

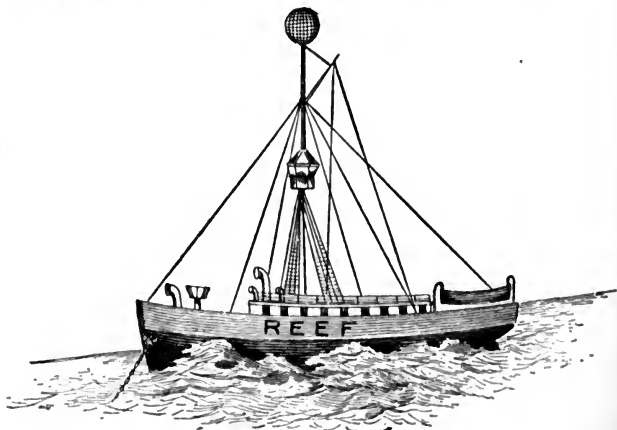
also of the building from the base to the vane, and its form, color, and other peculiarities.

Light-ships. The seas adjacent to the coast are sometimes interspersed with extensive shoals and shifting sandbanks, upon which it is impossible to erect light-houses. Nor can those already built upon the mainland be made serviceable in directing vessels their way through the narrow channels running in all directions, distant perhaps fifteen or twenty miles off the coast.

In approaching the sea immediately surrounding these dangers, light-ships or floating lights are used to indicate the exact points to be avoided. They also serve as beacons against variable currents and reefs which are hidden at certain hours by the high tide.

Each light-ship, like the light-house on shore, is distinguished by its own peculiar aspect, various characteristics, and certain differences in telling not only one from another, but also from any neighboring light-house.

How appear. When seen at some distance a light-ship closely resembles during the day an ordinary vessel, but upon approaching near a great difference between the two is seen. The short stout masts are without sails, and surmounted by large balls, cages, or other marks.



LIGHT-SHIP.

In Great Britain the hulls of light-ships are painted red and black. In the United States they are painted such color and in such a way as the Light-house Board may designate, with the name of the station painted on the sides and the number of the vessel on the stern.

At night these vessels are provided with one or more lights, and are distinguished by their number and position as well as characteristic distinction—such as single or double fixed lights, revolving lights with varying intervals of darkness between the beams, or with colored beams alternating with white, or colored beams only.

When two lights are used, it is usually the custom to place one higher than the other.

Few instances are on record of a light-ship having broken loose from her moorings. If, however, the ship should be driven from its place by the force of the elements, so that its light may become a source of danger, means are provided for signalling by flags or the firing of a gun. No one except those belonging to the light-ships is ever permitted to live on board or to remain at night, unless necessarily detained by stress of weather, or wrecked persons who may be compelled to take temporary refuge on board.

Buoys are the next very important marks that contribute greatly as aids to navigation. They are exceedingly numerous, and are invaluable as guiding marks by day through narrow channels and warning marks for isolated dangers. They are not very serviceable at night, being unilluminated; however, buoys have been lit in many instances by the application of compressed gas confined within the buoy; and it has been proposed to connect them with wires all around the coast, and to light them simultaneously with electricity.

Distinction. Their chief elements of distinction are the form, size, and color, which may be supplemented by the addition of a shape—such as globe, diamond, triangle, etc.—mounted on top of the mast fixed in the head of the buoy.

Names of Buoys. The names of the various forms are so unsettled, that but few persons can accurately state what constitutes the characteristic of each. However, the descriptive titles of buoys are: the nun, can, conical, convex, spiral, drum, cylinder, spherical, spar, mast, and cask. These terms are found to vary at different places, and are employed to give

exactly opposite indications ; also, intimations conveyed by colors vary at different places : hence, reference to name or disposition of colors is apt to lead to some confusion.

In France a uniform system of coloring is used, and on each is painted either the entire or abridged name of the rock or bank that it marks ; those belonging to the same channel are numbered serially, commencing to seaward. Those to mark the starboard side are painted red, having a white crown a little below the summit, and bear the even numbers. Those to mark the port side are painted black, and bear odd numbers. Those which may be left indifferently on either side are painted with horizontal stripes alternately red and black, bear names, but no numbers. The red and black are varied, as circumstances require, by painting in white designs of checks, vertical bands, etc.

In England the entrances to channels or turning-points are marked by conical buoys with or without staff, and globe or triangle, cage, etc. Single-colored can-buoys, either red or black, mark the starboard side, and buoys of the same shape and color, either checkered or vertical-striped with white, mark the port side. Other distinctions are used, when required, by the employment of conical buoys with or without staff, globe, or cage, globes being on the starboard side and cages on the port hand. Where a middle ground exists in a channel, each side of it is marked by a buoy of the color in use in that channel, but with annular bands of white, and with or without staff, diamond, or triangle. In case of its being of such extent as to require intermediate buoys, they are colored as if on the side of a channel. At times the outer buoy is marked by a staff and diamond, and the inner end by a staff and triangle. Wrecks are marked by green nun-buoys placed on the wreck next to mid-channel, with " Wreck " painted thereon ; also two balls or two lights, as the case may be.

Each buoy is marked with a running number, and the name of the locality where it belongs.

In the Netherlands, with few exceptions, white buoys must be left on the starboard hand on entering the channel from seaward, and black buoys on the port hand. Outside buoys, and those indicating where the division of a channel begins, are painted red. In Belgium the same system prevails. In Norway and Sweden a white stake with a broom turned up-

wards denotes that the shoal lies to the north or east of the mark. A black stake with a broom turned downwards denotes that the danger lies to the south or west of the mark. A stake with white and black horizontal stripes, surmounted by a ball or a pole with a cross at the top, may be passed on either side.

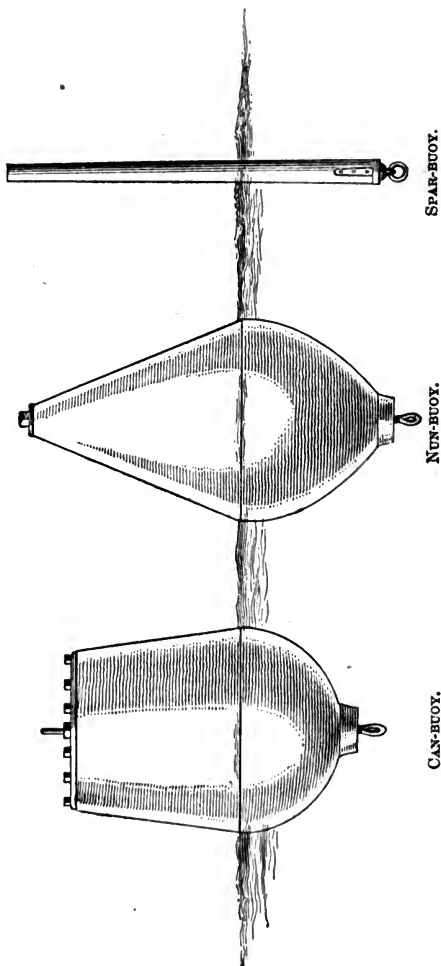
In Russia the system is nearly the same as in Norway, with this addition for the open sea : a red broom open upwards on a red pole means that the danger lies to the north ; a black broom open downwards on a white pole means that the danger lies to the south. Two black brooms on a black and white checkered pole mean that the danger lies to the west ; and a black pole with cross at the top surmounted by a ball means that a vessel can pass on all sides.

In the United States the largest descriptions of buoys are used to mark approaches to channels, seaward bars, and isolated shoals or other obstructions to navigation which lie at considerable distance from the coast. First and second class buoys mark the approaches to, the obstructions in, and to point out and mark the limits of channels leading to the principal ports or harbors along the coast.

They also mark the channels and obstructions adjacent to the coast and those in the large bays and sounds. Second and third class buoys mark the approaches to, and channels and obstructions of, the lesser harbors and bays. Nun and can buoys liable to danger or to be swept away by floating ice are removed on the approach of freezing weather, and spar-buoys put in their places. Small spar-buoys mark channels and obstructions in shoal-water navigation.

Special buoys, such as spherical and cask buoys, colored and numbered, are used to mark special localities. All buoys are placed in the best position to mark obstructions or define channels, and float as high and as nearly upright as possible during the strongest wind and tide. White serial numbers, as large as the class of buoy will permit, are placed on four sides of red and black buoys, and other distinguishing marks are made to show as prominently and at as great a distance as possible.

Different channels in the same bay, sound, river, or harbor are marked as far as practicable by different descriptions of buoys.



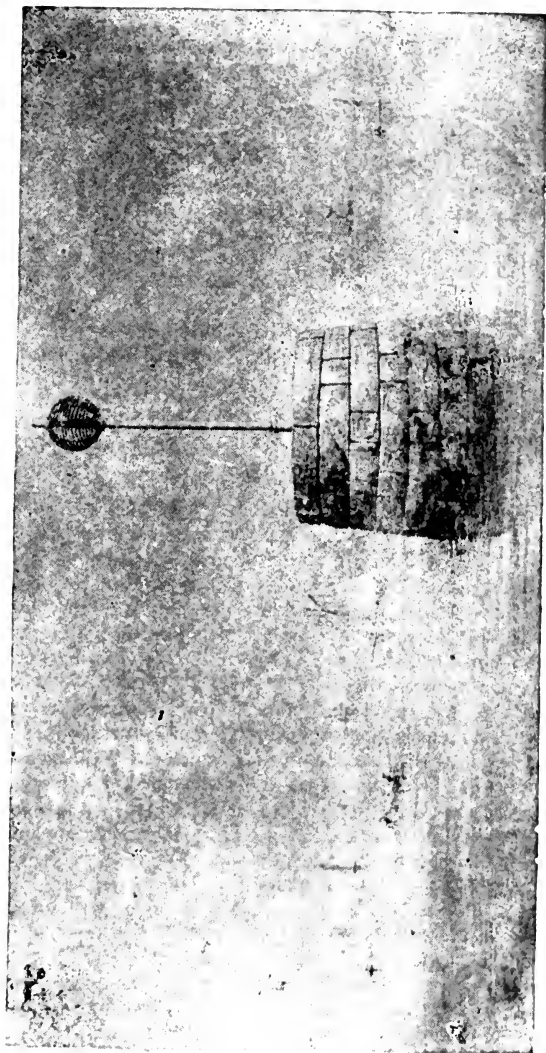
The main channel is marked by nun-buoys ; can-buoys indicate secondary channels, and spar-buoys minor channels. When there is but one channel, nun-buoys properly colored and numbered are placed on the starboard side and can-buoys on the port side.

On entering the channel from seaward red buoys with even numbers are placed on the starboard side of the channel, and must be left on the starboard hand in passing in. Black buoys with odd numbers are placed on the port side of the channel, and must be left on the port hand in passing in. Buoys painted with red and black horizontal stripes without numbers are placed on rocks or other obstructions with channels on either side of them, and may be left on either hand in passing in. Buoys painted with black and white vertical stripes without numbers are placed in mid-channel, and must be passed close to avoid danger. Buoys to mark abrupt turning-points in channels or obstructions requiring a specific and permanent mark are fitted with staves surmounted by balls, cages, triangles, or other distinctive marks, the color indicating which side they shall be passed. Yellow buoys without numbers are used to mark any danger at a quarantine station.

The bearings from one mid-channel buoy to another in the order of passing to other buoys or objects, the name of the station or position occupied, the color, number, description, class, depth of water at mean low tide, kind of bottom, and such other marks to aid navigation will be found in the proper column of the buoy list.

Beacons are small but durable structures of timber, masonry, or iron, placed on low, outstretching points of land, rocks and sand-banks, shoals or elsewhere, which at certain times of the tide are hidden from view, in estuaries and broad parts of rivers. They serve as leading marks through certain channels for the avoidance of special dangers, and as a guide for entering harbors or anchorage ground.

Every beacon set up has some especial characteristic, so that it may be recognized, being usually surmounted with a characteristic head in the form of a globe, diamond, cross, or triangle. Beacons are painted in such a manner that the color will cause them to be well defined upon the background, and those on sides of channels are painted the same as buoys. Some of these beacons are provided with a ladder leading up



BEACON ON SEA-FLLOWER REEF, L. I. SOUND.

to a refuge cage above the high-water mark, capable of holding several persons. As a general rule, beacons are not lighted up at night; yet several arrangements have been devised for lighting beacons on detached rocks which are inaccessible during rough weather.

Sound-signals. The various marks so far dealt with are those which depend upon the sense of sight only, but when sight is unavailing, the sense of hearing naturally suggests itself when sound-signals have to be used as aids to navigation, especially during fogs, mists, and snow-storms. These sound-signals are, with certain modifications: sirens, trumpets, steam-whistles, bell-buoys, whistling-buoys, bells struck by machinery, cannons, rockets, and gongs.

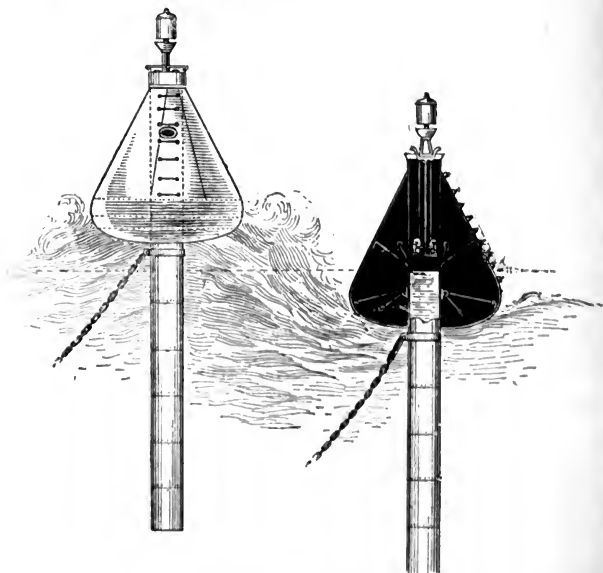
Gongs are sometimes used on light-ships and for close quarters, having an effective range of about 500 yards. They are of most use in harbors, short channels, and like places, where a long range would be unnecessary.

Rockets are used in light-houses as a signal where it would be impossible to mount large pieces of apparatus. It frequently happens that the sound-signal intended to be heard at a certain distance is obstructed or deflected by intervening obstacles; the rocket in this case overcomes the difficulty. The charge, usually of gun-cotton, is fitted to the head, and the whole projected to the height of perhaps 1000 feet, when the charge is exploded, and sound scattered in all directions, with greater effect than the report of a gun. Some of these rockets have been heard at a distance of twenty-five miles.

Cannon are used for various purposes in connection with signalling. The minute-gun at sea indicates that the vessel is in distress, and that assistance is required. On some light-ships the cannon is used to attract attention of shipwrecked life-boats. They are also used as warning signals on headlands and dangerous points on a coast, as aids to navigation in foggy weather, as well as for signalling in accordance with an arranged code. Owing to the short duration of sound, the use of the cannon is not so great as it once was, as the observer, either through lack of attention or otherwise, may not hear unless prepared for it, the sound being liable to be quenched by local sounds, or even obliterated by a puff of wind. The interval between each shot was formerly fifteen

minutes, but recently it has been altered to ten; owing, however, to the severe labor and risks accompanying it, this interval is of considerable irregularity.

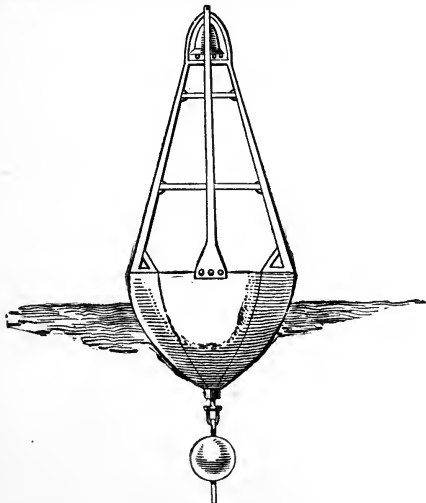
Bells are in use at every light-station, and at many they are run by machinery actuated by clockwork. These bells weigh from 300 to 3000 pounds. The sound of a bell is curiously fluctuating, and the vibrations of the largest bells are not of sufficient intensity to yield a sound capable of overcoming opposing influences, even of a slight nature, and the effective range is at times very doubtful. However, it has been shown by experiments that the range of bell sounds can be increased with the rapidity of the stroke; it has also been somewhat increased by the use of iron reflectors. By this it will be seen that the bell is only used, like the gong, for short distances, and is not efficient for fog-signals on the sea-coast. Owing to rough weather, the noises of the surf will drown the sound to seaward altogether.



COURTENAY'S WHISTLING-BUOY.

The Whistling-buoy, devised by Mr. Courtenay, is extensively employed in various parts of the world. It has a powerful whistle fixed at the top, and sounded automatically by the action of the sea, on the passage of any wave or undulation, which will cause the instrument to rise and fall six inches or more. It will emit a sound that can be heard distinctly from one to fifteen miles,—a mournful sound, which, though of great aid to navigation, is most obnoxious to those who live within ear-shot. They can be used on shoals, where a light-ship is needed but could not live; and are well suited for broken and turbulent waters, as the rougher the sea the louder their sound: they are also employed for roadsteads and the open sea.

The Bell-buoy consists of a buoy with a bell so attached that it will cause the bell to strike as the buoy is moved from side to side by the action of the sea. Like the whistling-buoy, the bell-buoy sounds the loudest when the sea is roughest, but is adapted to shoal water, where the whistling-buoy could not ride. It is preferred for harbors, rivers, and other places where the sound range needed is short.



BELL-BUOY.

Steam-whistles for signalling in a fog are the same instruments ordinarily used on steamboats and locomotives. They have been heard at distances, varying with their diameter, of from three to twenty-five miles.

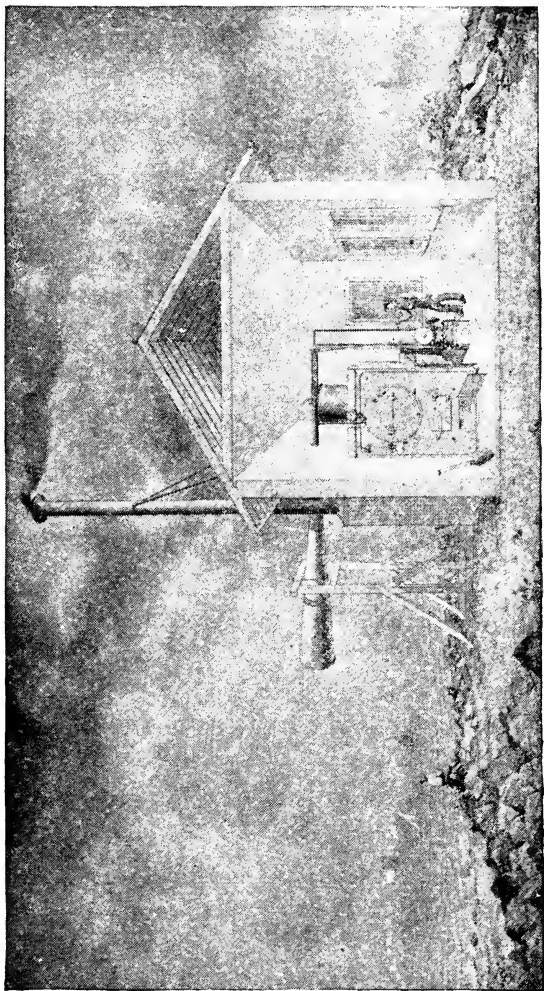
The Trumpet comes next in order, and is simply a horn that is capable of making shrieks which can be heard at a great distance, and is superior to the whistle, having greater penetrating effect.

The Siren is beyond all doubt the most powerful fog-signal in use, and when operated under a pressure of seventy pounds of steam can be heard, under favorable circumstances, from twenty to thirty miles. Its density, pitch, and penetration render it dominant over noises after all other signal sounds have succumbed, especially under meteorological conditions unfavorable to the transmission of sound.

The trumpet, siren, and whistle are capable of such arrangement that the length of blast and interval and the succession of alternating are such as to identify the location of each, so that the position may be determined by the sound. Double sirens of different pitch are sometimes used. There are in addition to these, in various parts of the world, several sound-signals made by utilizing natural orifices in cliffs, through which the waves drive the air in such force and velocity as to produce the sound required.

Sound-signals constitute a large factor in the safety of navigation, and it is necessary that every signal should have its own characteristic to particularly indicate itself, as a light-house is made to proclaim its own individuality by some distinguishing feature. The effect of different atmospheric conditions upon the transmission of sound is very marked, and it has been found by repeated trials that the sound range varies on clear, calm days; hence the minimum range should always be taken as the guide when running by sound. A most important phenomenon, affording confidence in sound-signalling when a light is rendered ineffectual, is the fact that a foggy atmosphere appears to be a highly favorable condition for the transmission of sound; while rain, hail, and snow offer no obstruction, but, on the contrary, have the effect of assisting the passage of sound.

It will be seen from the above that a vessel coming to the coast from beyond the sea will pick up the proper coast-light



THE SYREN.

in fair weather, and in thick weather the fog-signal, and take either as a point of departure and feel the way to the harbor light or fog-signal in the port, thence to a safe anchorage, with comparative security.

CHAPTER XIII.

REGULATIONS FOR PREVENTING COLLISIONS AT SEA.

THE laws of all Maritime Nations require a strict observance of the following rules and regulations for the prevention of collisions at sea.

“ART. 1. In the following rules every steamship which is under sail and not under steam is to be considered a sailing-ship, and every steamship which is under steam, whether under sail or not, is to be considered a ship under steam.

“RULES CONCERNING LIGHTS.

“ART. 2. The lights mentioned in the following articles numbered three, four, five, six, seven, eight, nine, ten, and eleven, and no others, shall be carried in all weathers, from sunset to sunrise.

“ART. 3. A sea-going steamship, when under way, shall carry—

“(a) On or in front of the foremast, at a height above the hull of not less than twenty feet, and if the breadth of the ship exceeds twenty feet, then at a height above the hull not less than such breadth, a bright white light, so constructed as to show a uniform and unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the ship, namely, from right ahead to two points abaft the beam on either side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least five miles.

“(b) On the starboard side a green light, so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard

side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles.

“(c) On the port side a red light, so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles.

“(d) The said green and red side-lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

“ART. 4. A steamship when towing another ship shall, in addition to her side-lights, carry two bright white lights in a vertical line, one over the other, not less than three feet apart, so as to distinguish her from other steamships. Each of these lights shall be of the same construction and character, and shall be carried in the same position, as the white light which other steamships are required to carry.

“ART. 5. (a) A ship, whether a steamship or a sailing-ship, which from any accident is not under command, shall at night carry, in the same position as the white light which steamships are required to carry, and if a steamship, in place of that light, three red lights in globular lanterns, each not less than ten inches in diameter, in a vertical line, one over the other, not less than three feet apart, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles, and shall by day carry in a vertical line, one over the other, not less than three feet apart, in front of but not lower than her foremast-head, three black balls or shapes, each two feet in diameter.

“(b) A ship, whether a steamship or a sailing-ship, employed in laying or in picking up a telegraph cable, shall at night carry, in the same position as a white light which steamships are required to carry, and if a steamship, in place of that light, three lights in globular lanterns, each not less than ten inches in diameter, in a vertical line, over one another, not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character that the red lights shall be visible at the same distance as the white light. By day she shall carry, in a

vertical line, one over the other, not less than six feet apart, in front of but not lower than her foremast head, three shapes not less than two feet in diameter, of which the top and bottom shall be globular in shape and red in color, and the middle one diamond in shape and white.

“(c) The ships referred to in this article when not making any way through the water shall not carry the side-lights, but when making way shall carry them.

“(d) The lights and shapes required to be shown by this article are to be taken by other ships as signals that the ship showing them is not under command, and cannot therefore get out of the way. The signals to be made by ships in distress and requiring assistance are contained in article twenty-seven.

“ART. 6. A sailing-ship under way or being towed shall carry the same lights as are provided by article three for a steamship under way, with the exception of the white light, which she shall never carry.

“ART. 7. Whenever, as in the case of small vessels during bad weather, the green and red side-lights cannot be fixed, these lights shall be kept on deck, on their respective sides of the vessel, ready for use, and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side. To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

“ART. 8. A ship, whether a steamship or a sailing-ship, when at anchor, shall carry, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light, in a globular lantern of not less than eight inches in diameter, and so constructed as to show a clear, uniform, and unbroken light, visible all round the horizon at a distance of at least one mile.

“ART. 9. A pilot vessel, when engaged on her station on pilotage duty, shall not carry the lights required for other vessels, but shall carry a white light at the mast-head, visible all round the horizon, and shall also exhibit a flare-up light

or flare-up lights at short intervals, which shall never exceed fifteen minutes. A pilot vessel, when not engaged on her station on pilotage duty, shall carry lights similar to those of other ships.

“ART. 10. Open boats and fishing-vessels of less than twenty tons net registered tonnage, when under way and not when having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the colored side-lights ; but every such boat and vessel shall in lieu thereof have ready at hand a lantern with a green glass on the one side and a red glass on the other side, and on approaching to or being approached by another vessel such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

“The following portion of this article applies only to fishing-vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre :

“(a) All fishing-vessels and fishing-boats of twenty tons net registered tonnage or upward, when under way and when not having their nets; trawls, dredges, or lines in the water, shall carry and show the same lights as other vessels under way.

“(b) All vessels when engaged in fishing with drift-nets shall exhibit two white lights from any part of the vessel where they can be seen. Such lights shall be placed so that the vertical distance between them shall not be less than six feet and not more than ten feet, and so that the horizontal distance between them, measured in a line with the keel of the vessel, shall be not less than five feet and not more than ten feet. The lower of these two lights shall be the more forward, and both of them shall be of such a character and contained in lanterns of such construction as to show all round the horizon, on a dark night, with a clear atmosphere, for a distance of not less than three miles.

“(c) All vessels when trawling, dredging, or fishing with any kind of drag-nets shall exhibit, from some part of the vessel where they can be best seen, two lights. One of these lights shall be red and the other shall be white. The red light shall be above the white light, and shall be at a vertical distance from it of not less than six feet and not more than twelve feet ; and the horizontal distance between them, if any, shall not be more than ten feet. These two lights shall be of

such a character and contained in lanterns of such construction as to be visible all round the horizon, on a dark night, with a clear atmosphere, the white light to a distance of not less than three miles and the red light of not less than two miles.

“(d) A vessel employed in line-fishing, with her lines out, shall carry the same lights as a vessel when engaged in fishing with drift-nets.

“(e) If a vessel when fishing with a trawl, dredge, or any kind of drag-net, becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall show the light and make the fog-signal for a vessel at anchor.

“(f) Fishing-vessels and open boats may at any time use a flare-up in addition to the lights which they are by this article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag-net shall be shown at the afterpart of the vessel, excepting that if the vessel is hanging by the stern to her trawl, dredge, or drag-net they shall be exhibited from the bow.

“(g) Every fishing-vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light, visible all round the horizon at a distance of at least one mile.

“(h) In a fog a drift-net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of drag-net, and a vessel employed in line-fishing with her lines out, shall, at intervals of not more than two minutes, make a blast with her fog-horn, and ring her bell alternately.”

Attention is called to paragraphs “a” and “c” of this article, which have not been adopted by foreign governments.

Paragraph “a” has been modified by the British Government to read as follows, viz.:

“All fishing vessels and fishing-boats of twenty tons net registered tonnage or upwards, when under way and when not required by the following regulations in this article to carry and show the lights therein named, shall carry and show the same lights as other vessels under way.”

Paragraph “c” has been omitted.

But these two provisions apply only to “fishing-vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre.”

“ART. 11. A ship which is being overtaken by another

shall show from her stern to such last-mentioned ship a white light or a flare-up light.

“SOUND SIGNALS FOR FOG, AND SO FORTH.

“ART. 12. A steamship shall be provided with a steam-whistle or other efficient steam sound-signals, so placed that the sound may not be intercepted by any obstructions, and with an efficient fog-horn, to be sounded by a bellows or other mechanical means, and also with an efficient bell. (In all cases where the regulations require a bell to be used, a drum will be substituted on board Turkish vessels.) A sailing-ship shall be provided with a similar fog-horn and bell.

“In fog, mist, or falling snow, whether by day or night, the signals described in this article shall be used as follows, that is to say :

“(a) A steamship under way shall make with her steam-whistle or other steam sound-signal, at intervals of not more than two minutes, a prolonged blast.

“(b) A sailing-ship under way shall make with her fog-horn, at intervals of not more than two minutes, when on the starboard tack one blast, when on the port tack two blasts in succession, and when with the wind abaft the beam three blasts in succession.

“(c) A steamship and a sailing-ship when not under way shall, at intervals of not more than two minutes, ring the bell.

“SPEED OF SHIPS TO BE MODERATE IN FOG, AND SO FORTH.

“ART. 13. Every ship, whether a sailing-ship or a steamship, shall in a fog, mist, or falling snow go at a moderate speed.

“STEERING AND SAILING RULES.

“ART. 14. When two sailing-ships are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other as follows, namely :

“(a) A ship which is running free shall keep out of the way of a ship which is close-hauled.

“(b) A ship which is close-hauled on the port tack shall keep out of the way of a ship which is close-hauled on the starboard tack.

“(c) When both are running free, with the wind on different sides, the ship which has the wind on the port side shall keep out of the way of the other.

“(d) When both are running free, with the wind on the same side, the ship which is to windward shall keep out of the way of the ship which is to leeward.

“(e) A ship which has the wind aft shall keep out of the way of the other ship.

“ART. 15. If two ships under steam are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other. This article only applies to cases where ships are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two ships which must, if both keep on their respective courses, pass clear of each other. The only cases to which it does apply are when each of the two ships is end on, or nearly end on, to the other; in other words, to cases in which by day each ship sees the masts of the other in a line, or nearly in a line, with her own, and by night to cases in which each ship is in such a position as to see both the side-lights of the other. It does not apply by day to cases in which a ship sees another ahead crossing her own course, or by night to cases where the red light of one ship is opposed to the red light of the other, or where the green light of one ship is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

“ART. 16. If two ships under steam are crossing so as to involve risk of collision, the ship which has the other on her own starboard side shall keep out of the way of the other.

“ART. 17. If two ships, one of which is a sailing-ship and the other a steamship, are proceeding in such directions as to involve risk of collision, the steamship shall keep out of the way of the sailing-ship.

“ART. 18. Every steamship, when approaching another ship so as to involve risk of collision, shall slacken her speed, or stop and reverse, if necessary.

“ART. 19. In taking any course authorized or required by these regulations, a steamship under way may indicate that

course to any other ship which she has in sight by the following signals on her steam-whistle, namely :

“ One short blast to mean ‘ I am directing my course to starboard.’ ”

“ Two short blasts to mean ‘ I am directing my course to port.’ ”

“ Three short blasts to mean ‘ I am going full speed astern.’ ”

“ The use of these signals is optional, but if they are used the course of the ship must be in accordance with the signal made.

“ ART. 20. Notwithstanding anything contained in any preceding article, every ship, whether a sailing-ship or a steam-ship, overtaking any other shall keep out of the way of the overtaken ship.

“ ART. 21. In narrow channels every steamship shall, when it is safe and practicable, keep to that side of the fairway or mid-channel which lies on the starboard side of such ship.

“ ART. 22. Where by the above rules one of two ships is to keep out of the way, the other shall keep her course.

“ ART. 23. In obeying and construing these rules due regard shall be had to all dangers of navigation, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

“ NO SHIP, UNDER ANY CIRCUMSTANCES, TO NEGLECT PROPER PRECAUTIONS.

“ ART. 24. Nothing in these rules shall exonerate any ship, or the owner, or master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen or by the circumstances of the case.

“ RESERVATION OF RULES FOR HARBOR AND INLAND NAVIGATION.

“ ART. 25. Nothing in these rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbor, river, or inland navigation.

“SPECIAL LIGHTS FOR SQUADRONS AND CONVOYS.

“ART. 26. Nothing in these rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal lights for two or more ships of war or for ships sailing under convoy.

“ART. 27. When a ship is in distress and requires assistance from other ships or from the shore, the following shall be the signals to be used or displayed by her, either together or separately, that is to say :

“In the daytime—

“First. A gun fired at intervals of about a minute.

“Second. The international code signal of distress indicated by N. C.

“Third. The distant signal, consisting of a square flag, having either above or below it a ball, or anything resembling a ball.

“At night—

“First. A gun fired at intervals of about a minute.

“Second. Flames on the ship (as from a burning tar-barrel, oil-barrel, and so forth).

“Third. Rockets or shells, throwing stars of any color or description, fired one at a time, at short intervals.”

RELIEF OF THE SICK AND THE WOUNDED.

ALL commands are liable to be called upon in case of accident to resort to expedients to relieve the sick and wounded in the absence of a doctor. Every one should know how to make a stretcher and how to transport one. The following stretchers may be readily extemporized: 1. A blanket is held by four men, one at each corner, and is then doubled so that the two loops shall be brought together at each end; one pole (or two rifles lashed together) passes through the four loops, while another passes within the double of the blanket on the other side. 2. Roll a small stone into each corner of the blanket and thus form projections which will prevent the slipping of the string or thongs with which it is made fast to a frame of poles, or rifles lashed together. Two coats and four muskets passed through the sleeves makes a good stretcher. Avoid carrying the stretcher on the shoulders. The front and rear bearers of the stretcher should not be out of step, and men of equal height and strength should be selected. The sick or wounded man should be carried with his face toward the direction in which he is moving. In crossing hollows, fences, etc., the stretcher should be kept horizontal. Each officer and non-commissioned officer on going into the field should carry on his person a bandage and a piece of lint, and should understand how to put on a bandage so as to stop severe hemorrhages.

Sunstroke may be prevented by wearing a silk handkerchief in the crown of the hat, by a wet cloth, or by moistened green leaves or grass.

A wounded man is always thirsty; give him cold water, but never spirits. An old soldier drinks and eats as little as possible while marching. For sunstroke remove the collar, loosen the shirt and coat, and continue to throw cold water on the head and spine. For severe cramps, apply hot rocks or pans to the feet and hot fomentations to the stomach.

Men should keep the hair of the head closely cut and the

scalp plentifully washed in cold water every morning. The feet should be washed every night, which will prevent chafing and blistering, and it is the duty of the officers to see that the men properly police themselves and keep clean.

Poisons. For poisonous acids, such as nitric, oxalic, muriatic, or sulphuric acid, avoid emetics. For nitrate of silver give plenty of salt water, followed by barley water or gruel. For strychnine, narcotic poisons, opium, mushrooms, belladonna, etc., give strong emetics at once, pour cold water on the head, neck, and shoulders, place mustard poultices on the feet and keep the person moving about, giving strong coffee as a stimulant. A charge of gunpowder in a tumblerful of warm water, or soap-suds, will make a good emetic. Poison from the bites of insects should be treated by laying a handkerchief lightly above the wound and apply a caustic; if you have none, burn the wound deeply with an iron heated to a white heat, and use utmost exertion to keep the patient from going to sleep. Administer spirits, for wasp and scorpion stings, extract the sting, and rub acetic acid, the nicotine from a pipe, or chewed tobacco upon the wound.

Wounds. The most universally safe position, after all stunning hurts and wounds, is that of being placed on the back, the head being elevated three or four inches only. *Incised wounds*, such as are made by a sword or knife, should be carefully cleansed, all extraneous substances removed, the edges brought together, adhesive plaster applied, and the muscles nearly relaxed. *Punctured wounds*, such as are made by bayonets, pointed rocks, etc., very often excite inflammation in their vicinity, cause formation of matter under the fascia, and frequently result in hemorrhage. The wounded part should be kept at rest, all subcutaneous oozing of the blood prevented, and an exit made for the discharge. If supuration sets in, an incision should be made at once in order to let out the pus. Probing in search of extraneous matter is very hurtful. *Lacerated wounds*, such as are inflicted by blunt and obtuse bodies, are invariably attended with severe pains, are slow in healing, and are liable to gangrene. They should be thoroughly cleansed, all foreign bodies removed, and the flaps of torn skin replaced as far as possible. A good poultice and disinfectant should be applied to the wound. *Contused wounds*, such as are produced by any blows without

breaking the skin, should be attended to without delay, the parts restored to the normal state by a few days of rest, and some stimulating liniment applied. For a contusion of the head, apply cold water, administer cathartics, make the diet light, take no stimulants, and remain quiet. For scalp wounds cleanse the exposed surface and replace the torn scalp; the parts will generally heal; if abscesses form they should be evacuated by timely incisions. In treatment of wounds the diet should be carefully attended to. In cases of a wounded lung it is necessary to reduce the patient to nearly a state of starvation. Ice, if procurable, will subdue inflammatory symptoms.

Broken Bones. If the skin is uninjured a broken arm or leg is not apt to prove serious, but great care must be observed not to injure the skin, as, if the broken bones force their way through the flesh, abscesses are apt to form and the parts mortify. If a man have either legs or ribs broken, make a stretcher and so carry him, taking care to keep the stretcher as nearly horizontal as possible. When a man has broken his leg, lay him on the other side, put the broken limb exactly on the sound one, with a little straw between, and tie the two legs together with handkerchiefs. When fractures occur and there are no splints at hand, they must be improvised from such materials as may be found. If the thigh be fractured, a rifle may be used for a splint, passed along outside of the limb and secured by bandages around the leg and ankle. A fracture of the arm may be put up with a bayonet scabbard, or with thin bundles of straw or grass. The forearm should be carefully supported in a sling. In case a severe shock or collapse from pain or nervous fear follows a fracture, a stimulant should be administered.

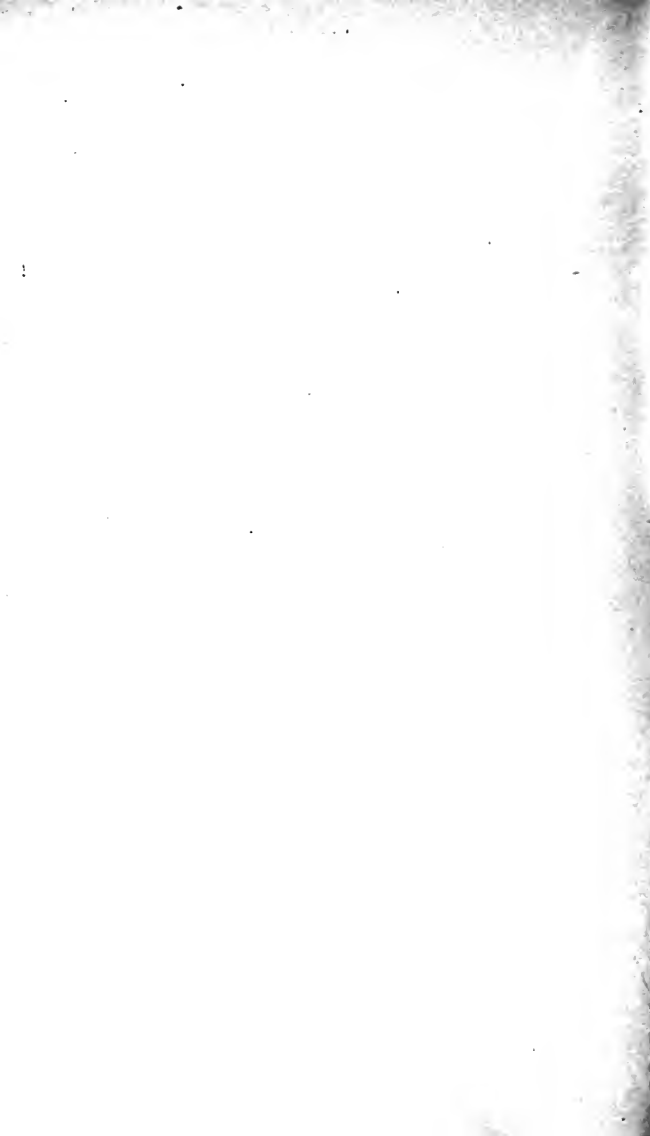
Bleeding. To know how to arrest bleeding is all-important. If the flow pours or trickles in a steady stream from a wound it is not apt to prove serious, and all that is necessary is to bind the wound tightly with a handkerchief or pieces of lint; but if the blood spurts out at regular intervals and is of a bright red color, an artery is wounded and the patient will bleed to death, unless the bleeding is stopped. Tie a handkerchief or string tightly above the part, put a stick through the knot, and twist it round until the bleeding stops; tie a ligature or pad over the wound, and slightly loosen the

handkerchief. After this keep the wounded limb still, well raised, and cool until the wound is nearly healed.

Blistered Feet. Rub the feet before retiring with spirits mixed with tallow or grease, or soap is good. To keep the feet from blistering, soap the inside of the sock before putting it on, or rub the feet well with soap. If the feet ache, change the socks. If one foot only hurts, turn the sock inside out, and it is an excellent plan to have two pairs of shoes to be worn on alternate days. While on the march, let the men lie down the moment they halt for rest. If corns should bother, soak the feet well in warm water, rub a few drops of sweet oil into the top of the corn, then cut a hole through a small piece of buckskin large enough to receive the corn, and attach it to the toe. At night saturate a small piece of cotton with pure water, having ten per cent of carbolic acid in it, and place over the corn; in the morning the corn can be scraped out with a dull knife.

When exposed to a marshy atmosphere or in the presence of epidemics, invariably filter all the drinking and cooking water and dilute it with spirits; the water should be boiled also.

TABLES.



EXPLANATION OF TABLES.

Table I contains the difference of latitude and departure corresponding to distances not exceeding 300 miles, and for courses to every degree of the compass.

The manner of using this table is explained in the different problems of dead-reckoning.

Table II gives the refraction, dip of the horizon, and the sun's parallax in altitude; the application of these is explained in the text under the definition of each on page 39.

Table III gives the declination of the sun to the nearest minute for every noon at Greenwich from the year 1886 to 1901, and this table will answer for some years beyond that period, without any material error. This declination may be reduced to any other meridian in the following manner: Take from the table the declination of the same date as the local date and mark it $+$ when *north* and $-$ when *south*, and apply a correction equal to the "difference for one hour," multiplied by the hours and part of an hour of the longitude, adding or subtracting the correction as the sign in the table indicates; for a time *after* noon if the longitude is *west*, for a time *before* noon if the longitude is *east*.

EXAMPLE. At a place in longitude $81^{\circ} 15' W.$ on April 15, 1887, find the declination. Longitude $81^{\circ} 15' W. = + 5^h.42.$

| | |
|-----------------------------------|-------------------------|
| Table III. Dec. $+ 9^{\circ} 45'$ | Diff. one hour $+ 54''$ |
| Corr. for $+ 5^h.42 + 4\ 53$ | Long. $+ 5.42$ |
| Declination $+ 9\ 49\ 53.$ | $+ 292.68$ |
| | Corr. $+ 4' 53''$ |

Had this longitude been *east*, we should get, longitude $81^{\circ} 15' E. = - 5^h.42.$

| | |
|-----------------------------------|-------------------------|
| Table III. Dec. $+ 9^{\circ} 45'$ | Diff. one hour $+ 54''$ |
| Corr. for $- 5^h.42 - 4\ 53$ | Long. $- 5.42$ |
| Declination $+ 9\ 40\ 07$ | $- 292.68$ |
| | Corr. $- 4' 53''$ |

To find the declination for a given mean time at a given place proceed as follows: From the given mean time find the astronomical time, and the corresponding Greenwich date. Take from the table the declination for the nearest preceding mean time date, and the corresponding difference for one hour, noting the sign of each. Multiply the difference for one hour by the hours and parts of an hour of the remaining Greenwich time, and apply the correction according to the signs, adding if they are alike, and subtracting if they are unlike. If the given Greenwich time is nearer a following than a preceding date, it may be convenient to interpolate back from the following date.

EXAMPLE. At a given place in longitude $81^{\circ} 15' W.$ on April 15, 1887, 10 A.M., find the declination.

Local astronomical time $14^h 22^m 00^s$

Longitude $+ 5 \ 25$

Greenwich mean time $15 \ 3 \ 25$

Table III. Dec. $+ 9^{\circ} 45'$ Diff. one hour $+ 54''$

Corr. for G. M. T. $+ 3.03$ G. M. Time $+ 3.4$

Declination $+ 9 \ 48.03$ $+ 186.6$

Corr. $+ 3' 03''$

Table IV contains the equation of time for every noon at Greenwich, and is to be reduced to any other hour by means of **Table IVa**. Thus, suppose the equation of time was required for Feb. 21, 1888, at 10 A.M., corresponding to Feb. 20th, 22 hours, Table IV gives the equation of time for Feb. 20th, $14^m 00^s$, and for the 21st, $13^m 53^s$; the difference between the two is a daily decrease of 7^s . Now enter Table IVa, and with 7 at the top and 22 at the side, the corresponding 6 in the column is the number of seconds to subtract from $14^m 00^s$ to give the required equation of time, $13^m 54^s$. This 6 seconds would have been added had the equation of time been increasing. The equation of time thus found is to be applied to the apparent time, as stated at the head of the column in Table IV. To obtain the apparent time from the mean time, the equation of time is applied opposite to the heading in Table IV.

Table V contains the quantities that are convenient for finding the time, or the total error of the compass, by an altitude of the sun. To find the sine, secant, etc., for the degrees, minutes, and seconds of the date occurring in the problems, look for the degrees at the bottom of the page when

between 45° and 135° , otherwise at the top, the minutes being found in the column marked M., which stands on the side of the page on which the degrees are marked; and if the degrees are found at the top, the names, hour, sine, secant, etc., must also be found at the top; and if the degrees are found at the bottom, the names, hour, sine, secant, etc., must be found at the bottom. Opposite to the minutes will be found the sine, secant, etc., in the columns marked sine, secant, etc., respectively. Now, with the number of seconds in the left-hand column under M., take out the number in the nearest column marked "Diff.," which add to the sine, secant, etc., if increasing, or subtract if decreasing.

Thus, to find the *cosine* of $30^\circ 20' 20''$, with 30° at the top of the page and opposite to $20'$ under M. in the column marked *cosine*, will be found 9.93606. Now, with $20''$ in the left column of M., we find opposite in the nearest column of "Diff." the figure 2 to be subtracted from the cosine as it is decreasing, which gives the correct cosine, 9.93604. Should it be desired to find the degrees, minutes, and seconds corresponding to this cosine, we search in the column of cosines for the nearest figures to those given, which will be in the column under 30° , and opposite to the nearest number in the column M. corresponding to 30, will be found 20. Take the difference between the given number and the nearest in the column, which is 2. Now, with this 2, look in the nearest column of "Diff.," and as there are several numbers marked 2, take the middle one, opposite to which, in the left-hand column under M., will be found 16 or $30^\circ 20' 16''$, sufficiently near for all practicable purposes.

The method of finding the hours, minutes, and seconds corresponding to the sine, etc., is fully given in the text on finding the longitude.

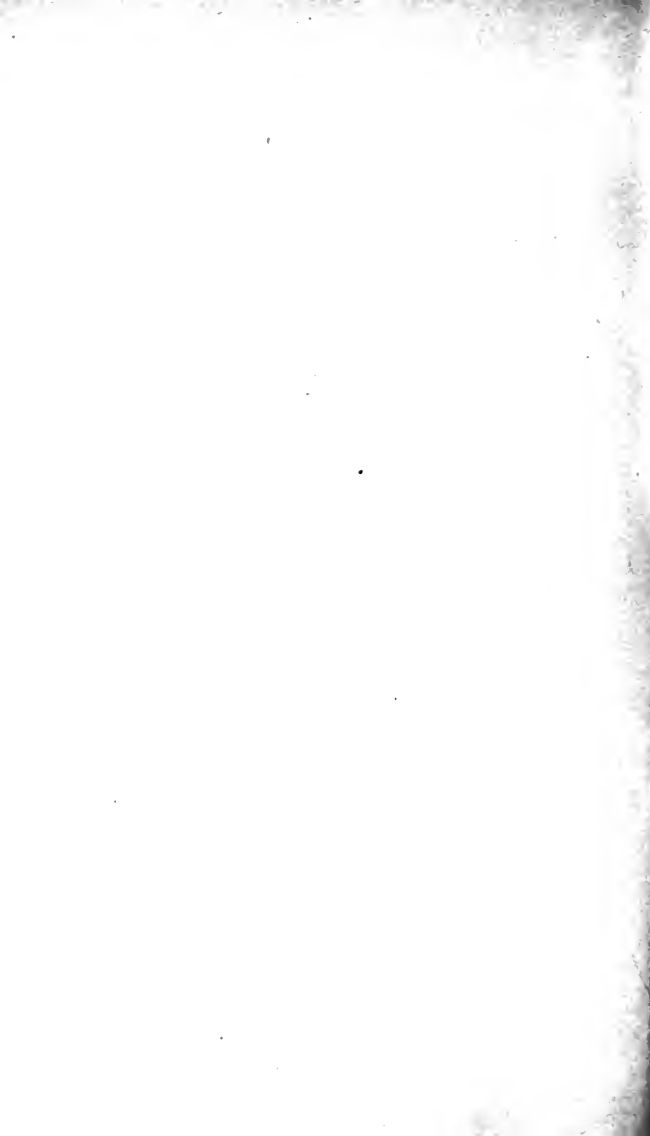


TABLE I.

DIFFERENCE OF LATITUDE AND DEPARTURE,

1°-45°.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 1°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.0 | 61 | 61.0 | 1.1 | 121 | 121.0 | 2.1 | 181 | 181.0 | 3.2 | 241 | 241.0 | 4.2 |
| 2 | 2.0 | 0.0 | 62 | 62.0 | 1.1 | 22 | 122.0 | 2.1 | 82 | 182.0 | 3.2 | 42 | 242.0 | 4.2 |
| 3 | 3.0 | 0.1 | 63 | 63.0 | 1.1 | 23 | 123.0 | 2.1 | 83 | 183.0 | 3.2 | 43 | 243.0 | 4.2 |
| 4 | 4.0 | 0.1 | 64 | 64.0 | 1.1 | 24 | 124.0 | 2.2 | 84 | 184.0 | 3.2 | 44 | 244.0 | 4.3 |
| 5 | 5.0 | 0.1 | 65 | 65.0 | 1.1 | 25 | 125.0 | 2.2 | 85 | 185.0 | 3.2 | 45 | 245.0 | 4.3 |
| 6 | 6.0 | 0.1 | 66 | 66.0 | 1.2 | 26 | 126.0 | 2.2 | 86 | 186.0 | 3.2 | 46 | 246.0 | 4.3 |
| 7 | 7.0 | 0.1 | 67 | 67.0 | 1.2 | 27 | 127.0 | 2.2 | 87 | 187.0 | 3.3 | 47 | 247.0 | 4.3 |
| 8 | 8.0 | 0.1 | 68 | 68.0 | 1.2 | 28 | 128.0 | 2.2 | 88 | 188.0 | 3.3 | 48 | 248.0 | 4.3 |
| 9 | 9.0 | 0.2 | 69 | 69.0 | 1.2 | 29 | 129.0 | 2.3 | 89 | 189.0 | 3.3 | 49 | 249.0 | 4.3 |
| 10 | 10.0 | 0.2 | 70 | 70.0 | 1.2 | 30 | 130.0 | 2.3 | 90 | 190.0 | 3.3 | 50 | 250.0 | 4.4 |
| 11 | 11.0 | 0.2 | 71 | 71.0 | 1.2 | 131 | 131.0 | 2.3 | 191 | 191.0 | 3.3 | 251 | 251.0 | 4.4 |
| 12 | 12.0 | 0.2 | 72 | 72.0 | 1.3 | 32 | 132.0 | 2.3 | 92 | 192.0 | 3.4 | 52 | 252.0 | 4.4 |
| 13 | 13.0 | 0.2 | 73 | 73.0 | 1.3 | 33 | 133.0 | 2.3 | 93 | 193.0 | 3.4 | 53 | 253.0 | 4.4 |
| 14 | 14.0 | 0.2 | 74 | 74.0 | 1.3 | 34 | 134.0 | 2.3 | 94 | 194.0 | 3.4 | 54 | 254.0 | 4.4 |
| 15 | 15.0 | 0.3 | 75 | 75.0 | 1.3 | 35 | 135.0 | 2.4 | 95 | 195.0 | 3.4 | 55 | 255.0 | 4.5 |
| 16 | 16.0 | 0.3 | 76 | 76.0 | 1.3 | 36 | 136.0 | 2.4 | 96 | 196.0 | 3.4 | 56 | 256.0 | 4.5 |
| 17 | 17.0 | 0.3 | 77 | 77.0 | 1.3 | 37 | 137.0 | 2.4 | 97 | 197.0 | 3.4 | 57 | 257.0 | 4.5 |
| 18 | 18.0 | 0.3 | 78 | 78.0 | 1.4 | 38 | 138.0 | 2.4 | 98 | 198.0 | 3.5 | 58 | 258.0 | 4.5 |
| 19 | 19.0 | 0.3 | 79 | 79.0 | 1.4 | 39 | 139.0 | 2.4 | 99 | 199.0 | 3.5 | 59 | 259.0 | 4.5 |
| 20 | 20.0 | 0.3 | 80 | 80.0 | 1.4 | 40 | 140.0 | 2.4 | 200 | 200.0 | 3.5 | 60 | 260.0 | 4.5 |
| 21 | 21.0 | 0.4 | 81 | 81.0 | 1.4 | 141 | 141.0 | 2.5 | 201 | 201.0 | 3.5 | 261 | 261.0 | 4.6 |
| 22 | 22.0 | 0.4 | 82 | 82.0 | 1.4 | 42 | 142.0 | 2.5 | 02 | 202.0 | 3.5 | 62 | 262.0 | 4.6 |
| 23 | 23.0 | 0.4 | 83 | 83.0 | 1.4 | 43 | 143.0 | 2.5 | 03 | 203.0 | 3.5 | 63 | 263.0 | 4.6 |
| 24 | 24.0 | 0.4 | 84 | 84.0 | 1.5 | 44 | 144.0 | 2.5 | 04 | 204.0 | 3.6 | 64 | 264.0 | 4.6 |
| 25 | 25.0 | 0.4 | 85 | 85.0 | 1.5 | 45 | 145.0 | 2.5 | 05 | 205.0 | 3.6 | 65 | 265.0 | 4.6 |
| 26 | 26.0 | 0.5 | 86 | 86.0 | 1.5 | 46 | 146.0 | 2.5 | 06 | 206.0 | 3.6 | 66 | 266.0 | 4.6 |
| 27 | 27.0 | 0.5 | 87 | 87.0 | 1.5 | 47 | 147.0 | 2.6 | 07 | 207.0 | 3.6 | 67 | 267.0 | 4.7 |
| 28 | 28.0 | 0.5 | 88 | 88.0 | 1.5 | 48 | 148.0 | 2.6 | 08 | 208.0 | 3.6 | 68 | 268.0 | 4.7 |
| 29 | 29.0 | 0.5 | 89 | 89.0 | 1.6 | 49 | 149.0 | 2.6 | 09 | 209.0 | 3.6 | 69 | 269.0 | 4.7 |
| 30 | 30.0 | 0.5 | 90 | 90.0 | 1.6 | 50 | 150.0 | 2.6 | 10 | 210.0 | 3.7 | 70 | 270.0 | 4.7 |
| 31 | 31.0 | 0.5 | 91 | 91.0 | 1.6 | 151 | 151.0 | 2.6 | 211 | 211.0 | 3.7 | 271 | 271.0 | 4.7 |
| 32 | 32.0 | 0.6 | 92 | 92.0 | 1.6 | 52 | 152.0 | 2.7 | 12 | 212.0 | 3.7 | 72 | 272.0 | 4.7 |
| 33 | 33.0 | 0.6 | 93 | 93.0 | 1.6 | 53 | 153.0 | 2.7 | 13 | 213.0 | 3.7 | 73 | 273.0 | 4.8 |
| 34 | 34.0 | 0.6 | 94 | 94.0 | 1.6 | 54 | 154.0 | 2.7 | 14 | 214.0 | 3.7 | 74 | 274.0 | 4.8 |
| 35 | 35.0 | 0.6 | 95 | 95.0 | 1.7 | 55 | 155.0 | 2.7 | 15 | 215.0 | 3.8 | 75 | 275.0 | 4.8 |
| 36 | 36.0 | 0.6 | 96 | 96.0 | 1.7 | 56 | 156.0 | 2.7 | 16 | 216.0 | 3.8 | 76 | 276.0 | 4.8 |
| 37 | 37.0 | 0.6 | 97 | 97.0 | 1.7 | 57 | 157.0 | 2.7 | 17 | 217.0 | 3.8 | 77 | 277.0 | 4.8 |
| 38 | 38.0 | 0.7 | 98 | 98.0 | 1.7 | 58 | 158.0 | 2.8 | 18 | 218.0 | 3.8 | 78 | 278.0 | 4.9 |
| 39 | 39.0 | 0.7 | 99 | 99.0 | 1.7 | 59 | 159.0 | 2.8 | 19 | 219.0 | 3.8 | 79 | 279.0 | 4.9 |
| 40 | 40.0 | 0.7 | 100 | 100.0 | 1.7 | 60 | 160.0 | 2.8 | 20 | 220.0 | 3.8 | 80 | 280.0 | 4.9 |
| 41 | 41.0 | 0.7 | 101 | 101.0 | 1.8 | 161 | 161.0 | 2.8 | 221 | 221.0 | 3.9 | 281 | 281.0 | 4.9 |
| 42 | 42.0 | 0.7 | 02 | 102.0 | 1.8 | 62 | 162.0 | 2.8 | 22 | 222.0 | 3.9 | 82 | 282.0 | 4.9 |
| 43 | 43.0 | 0.8 | 03 | 103.0 | 1.8 | 63 | 163.0 | 2.8 | 23 | 223.0 | 3.9 | 83 | 283.0 | 4.9 |
| 44 | 44.0 | 0.8 | 04 | 104.0 | 1.8 | 64 | 164.0 | 2.9 | 24 | 224.0 | 3.9 | 84 | 284.0 | 5.0 |
| 45 | 45.0 | 0.8 | 05 | 105.0 | 1.8 | 65 | 165.0 | 2.9 | 25 | 225.0 | 3.9 | 85 | 285.0 | 5.0 |
| 46 | 46.0 | 0.8 | 06 | 106.0 | 1.8 | 66 | 166.0 | 2.9 | 26 | 226.0 | 3.9 | 86 | 286.0 | 5.0 |
| 47 | 47.0 | 0.8 | 07 | 107.0 | 1.9 | 67 | 167.0 | 2.9 | 27 | 227.0 | 4.0 | 87 | 287.0 | 5.0 |
| 48 | 48.0 | 0.8 | 08 | 108.0 | 1.9 | 68 | 168.0 | 2.9 | 28 | 228.0 | 4.0 | 88 | 288.0 | 5.0 |
| 49 | 49.0 | 0.9 | 09 | 109.0 | 1.9 | 69 | 169.0 | 2.9 | 29 | 229.0 | 4.0 | 89 | 289.0 | 5.0 |
| 50 | 50.0 | 0.9 | 10 | 110.0 | 1.9 | 70 | 170.0 | 3.0 | 30 | 230.0 | 4.0 | 90 | 290.0 | 5.1 |
| 51 | 51.0 | 0.9 | 111 | 111.0 | 1.9 | 171 | 171.0 | 3.0 | 231 | 231.0 | 4.0 | 291 | 291.0 | 5.1 |
| 52 | 52.0 | 0.9 | 12 | 112.0 | 2.0 | 72 | 172.0 | 3.0 | 32 | 232.0 | 4.0 | 92 | 292.0 | 5.1 |
| 53 | 53.0 | 0.9 | 13 | 113.0 | 2.0 | 73 | 173.0 | 3.0 | 33 | 233.0 | 4.1 | 93 | 293.0 | 5.1 |
| 54 | 54.0 | 0.9 | 14 | 114.0 | 2.0 | 74 | 174.0 | 3.0 | 34 | 234.0 | 4.1 | 94 | 294.0 | 5.1 |
| 55 | 55.0 | 1.0 | 15 | 115.0 | 2.0 | 75 | 175.0 | 3.1 | 35 | 235.0 | 4.1 | 95 | 295.0 | 5.1 |
| 56 | 56.0 | 1.0 | 16 | 116.0 | 2.0 | 76 | 176.0 | 3.1 | 36 | 236.0 | 4.1 | 96 | 296.0 | 5.2 |
| 57 | 57.0 | 1.0 | 17 | 117.0 | 2.0 | 77 | 177.0 | 3.1 | 37 | 237.0 | 4.1 | 97 | 297.0 | 5.2 |
| 58 | 58.0 | 1.0 | 18 | 118.0 | 2.1 | 78 | 178.0 | 3.1 | 38 | 238.0 | 4.2 | 98 | 298.0 | 5.2 |
| 59 | 59.0 | 1.0 | 19 | 119.0 | 2.1 | 79 | 179.0 | 3.1 | 39 | 239.0 | 4.2 | 99 | 299.0 | 5.2 |
| 60 | 60.0 | 1.0 | 20 | 120.0 | 2.1 | 80 | 180.0 | 3.1 | 40 | 240.0 | 4.2 | 300 | 300.0 | 5.2 |

[For 89 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 2°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.0 | 61 | 61.0 | 2.1 | 121 | 120.9 | 4.2 | 181 | 180.9 | 6.3 | 241 | 240.9 | 8.4 |
| 2 | 2.0 | 0.1 | 62 | 62.0 | 2.2 | 22 | 121.9 | 4.3 | 82 | 181.9 | 6.4 | 42 | 241.9 | 8.4 |
| 3 | 3.0 | 0.1 | 63 | 63.0 | 2.2 | 23 | 122.9 | 4.3 | 83 | 182.9 | 6.4 | 43 | 242.9 | 8.5 |
| 4 | 4.0 | 0.1 | 64 | 64.0 | 2.2 | 24 | 123.9 | 4.3 | 84 | 183.9 | 6.4 | 44 | 243.9 | 8.5 |
| 5 | 5.0 | 0.2 | 65 | 65.0 | 2.3 | 25 | 124.9 | 4.4 | 85 | 184.9 | 6.5 | 45 | 244.9 | 8.6 |
| 6 | 6.0 | 0.2 | 66 | 66.0 | 2.3 | 26 | 125.9 | 4.4 | 86 | 185.9 | 6.5 | 46 | 245.9 | 8.6 |
| 7 | 7.0 | 0.2 | 67 | 67.0 | 2.3 | 27 | 126.9 | 4.4 | 87 | 186.9 | 6.5 | 47 | 246.8 | 8.6 |
| 8 | 8.0 | 0.3 | 68 | 68.0 | 2.4 | 28 | 127.9 | 4.5 | 88 | 187.9 | 6.6 | 48 | 247.8 | 8.7 |
| 9 | 9.0 | 0.3 | 69 | 69.0 | 2.4 | 29 | 128.9 | 4.5 | 89 | 188.9 | 6.6 | 49 | 248.8 | 8.7 |
| 10 | 10.0 | 0.3 | 70 | 70.0 | 2.4 | 30 | 129.9 | 4.5 | 90 | 189.9 | 6.6 | 50 | 249.8 | 8.7 |
| 11 | 11.0 | 0.4 | 71 | 71.0 | 2.5 | 131 | 130.9 | 4.6 | 191 | 190.9 | 6.7 | 251 | 250.8 | 8.8 |
| 12 | 12.0 | 0.4 | 72 | 72.0 | 2.5 | 32 | 131.9 | 4.6 | 92 | 191.9 | 6.7 | 52 | 251.8 | 8.8 |
| 13 | 13.0 | 0.5 | 73 | 73.0 | 2.5 | 33 | 132.9 | 4.6 | 93 | 192.9 | 6.7 | 53 | 252.8 | 8.8 |
| 14 | 14.0 | 0.5 | 74 | 74.0 | 2.6 | 34 | 133.9 | 4.7 | 94 | 193.9 | 6.8 | 54 | 253.8 | 8.9 |
| 15 | 15.0 | 0.5 | 75 | 75.0 | 2.6 | 35 | 134.9 | 4.7 | 95 | 194.9 | 6.8 | 55 | 254.8 | 8.9 |
| 16 | 16.0 | 0.6 | 76 | 76.0 | 2.7 | 36 | 135.9 | 4.7 | 96 | 195.9 | 6.8 | 56 | 255.8 | 8.9 |
| 17 | 17.0 | 0.6 | 77 | 77.0 | 2.7 | 37 | 136.9 | 4.8 | 97 | 196.9 | 6.9 | 57 | 256.8 | 9.0 |
| 18 | 18.0 | 0.6 | 78 | 78.0 | 2.7 | 38 | 137.9 | 4.8 | 98 | 197.9 | 6.9 | 58 | 257.8 | 9.0 |
| 19 | 19.0 | 0.7 | 79 | 79.0 | 2.8 | 39 | 138.9 | 4.9 | 99 | 198.9 | 6.9 | 59 | 258.8 | 9.0 |
| 20 | 20.0 | 0.7 | 80 | 80.0 | 2.8 | 40 | 139.9 | 4.9 | 200 | 199.9 | 7.0 | 60 | 259.8 | 9.1 |
| 21 | 21.0 | 0.7 | 81 | 81.0 | 2.8 | 141 | 140.9 | 4.9 | 201 | 200.9 | 7.0 | 261 | 260.8 | 9.1 |
| 22 | 22.0 | 0.8 | 82 | 82.0 | 2.9 | 42 | 141.9 | 5.0 | 02 | 201.9 | 7.0 | 62 | 261.8 | 9.1 |
| 23 | 23.0 | 0.8 | 83 | 82.9 | 2.9 | 43 | 142.9 | 5.0 | 03 | 202.9 | 7.1 | 63 | 262.8 | 9.2 |
| 24 | 24.0 | 0.8 | 84 | 83.9 | 2.9 | 44 | 143.9 | 5.0 | 04 | 203.9 | 7.1 | 64 | 263.8 | 9.2 |
| 25 | 25.0 | 0.9 | 85 | 84.9 | 3.0 | 45 | 144.9 | 5.1 | 05 | 204.9 | 7.2 | 65 | 264.8 | 9.2 |
| 26 | 26.0 | 0.9 | 86 | 85.9 | 3.0 | 46 | 145.9 | 5.1 | 06 | 205.9 | 7.2 | 66 | 265.8 | 9.3 |
| 27 | 27.0 | 0.9 | 87 | 86.9 | 3.0 | 47 | 146.9 | 5.1 | 07 | 206.9 | 7.2 | 67 | 266.8 | 9.3 |
| 28 | 28.0 | 1.0 | 88 | 87.9 | 3.1 | 48 | 147.9 | 5.2 | 08 | 207.9 | 7.3 | 68 | 267.8 | 9.4 |
| 29 | 29.0 | 1.0 | 89 | 88.9 | 3.1 | 49 | 148.9 | 5.2 | 09 | 208.9 | 7.3 | 69 | 268.8 | 9.4 |
| 30 | 30.0 | 1.0 | 90 | 89.9 | 3.1 | 50 | 149.9 | 5.2 | 10 | 209.9 | 7.3 | 70 | 269.8 | 9.4 |
| 31 | 31.0 | 1.1 | 91 | 90.9 | 3.2 | 151 | 150.9 | 5.3 | 211 | 210.9 | 7.4 | 271 | 270.8 | 9.5 |
| 32 | 32.0 | 1.1 | 92 | 91.9 | 3.2 | 52 | 151.9 | 5.3 | 12 | 211.9 | 7.4 | 72 | 271.8 | 9.5 |
| 33 | 33.0 | 1.2 | 93 | 92.9 | 3.2 | 53 | 152.9 | 5.3 | 13 | 212.9 | 7.4 | 73 | 272.8 | 9.5 |
| 34 | 34.0 | 1.2 | 94 | 93.9 | 3.3 | 54 | 153.9 | 5.4 | 14 | 213.9 | 7.5 | 74 | 273.8 | 9.6 |
| 35 | 35.0 | 1.2 | 95 | 94.9 | 3.3 | 55 | 154.9 | 5.4 | 15 | 214.9 | 7.5 | 75 | 274.8 | 9.6 |
| 36 | 36.0 | 1.3 | 96 | 95.9 | 3.4 | 56 | 155.9 | 5.4 | 16 | 215.9 | 7.5 | 76 | 275.8 | 9.6 |
| 37 | 37.0 | 1.3 | 97 | 96.9 | 3.4 | 57 | 156.9 | 5.5 | 17 | 216.9 | 7.6 | 77 | 276.8 | 9.7 |
| 38 | 38.0 | 1.3 | 98 | 97.9 | 3.4 | 58 | 157.9 | 5.5 | 18 | 217.9 | 7.6 | 78 | 277.8 | 9.7 |
| 39 | 39.0 | 1.4 | 99 | 98.9 | 3.5 | 59 | 158.9 | 5.5 | 19 | 218.9 | 7.6 | 79 | 278.8 | 9.7 |
| 40 | 40.0 | 1.4 | 100 | 99.9 | 3.5 | 60 | 159.9 | 5.6 | 20 | 219.9 | 7.7 | 80 | 279.8 | 9.8 |
| 41 | 41.0 | 1.4 | 101 | 100.9 | 3.5 | 161 | 160.9 | 5.6 | 221 | 220.9 | 7.7 | 281 | 280.8 | 9.8 |
| 42 | 42.0 | 1.5 | 02 | 101.9 | 3.6 | 62 | 161.9 | 5.7 | 22 | 221.9 | 7.7 | 82 | 281.8 | 9.8 |
| 43 | 43.0 | 1.5 | 03 | 102.9 | 3.6 | 63 | 162.9 | 5.7 | 23 | 222.9 | 7.8 | 83 | 282.8 | 9.9 |
| 44 | 44.0 | 1.5 | 04 | 103.9 | 3.6 | 64 | 163.9 | 5.7 | 24 | 223.9 | 7.8 | 84 | 283.8 | 9.9 |
| 45 | 45.0 | 1.6 | 05 | 104.9 | 3.7 | 65 | 164.9 | 5.8 | 25 | 224.9 | 7.9 | 85 | 284.8 | 9.9 |
| 46 | 46.0 | 1.6 | 06 | 105.9 | 3.7 | 66 | 165.9 | 5.8 | 26 | 225.9 | 7.9 | 86 | 285.8 | 10.0 |
| 47 | 47.0 | 1.6 | 07 | 106.9 | 3.7 | 67 | 166.9 | 5.8 | 27 | 226.9 | 7.9 | 87 | 286.8 | 10.0 |
| 48 | 48.0 | 1.7 | 08 | 107.9 | 3.8 | 68 | 167.9 | 5.9 | 28 | 227.9 | 8.0 | 88 | 287.8 | 10.1 |
| 49 | 49.0 | 1.7 | 09 | 108.9 | 3.8 | 69 | 168.9 | 5.9 | 29 | 228.9 | 8.0 | 89 | 288.8 | 10.1 |
| 50 | 50.0 | 1.7 | 10 | 109.9 | 3.8 | 70 | 169.9 | 5.9 | 30 | 229.9 | 8.0 | 90 | 289.8 | 10.1 |
| 51 | 51.0 | 1.8 | 111 | 110.9 | 3.9 | 171 | 170.9 | 6.0 | 231 | 230.9 | 8.1 | 291 | 290.8 | 10.2 |
| 52 | 52.0 | 1.8 | 12 | 111.9 | 3.9 | 72 | 171.9 | 6.0 | 32 | 231.9 | 8.1 | 92 | 291.8 | 10.2 |
| 53 | 53.0 | 1.8 | 13 | 112.9 | 3.9 | 73 | 172.9 | 6.0 | 33 | 232.9 | 8.1 | 93 | 292.8 | 10.2 |
| 54 | 54.0 | 1.9 | 14 | 113.9 | 4.0 | 74 | 173.9 | 6.1 | 34 | 233.9 | 8.2 | 94 | 293.8 | 10.3 |
| 55 | 55.0 | 1.9 | 15 | 114.9 | 4.0 | 75 | 174.9 | 6.1 | 35 | 234.9 | 8.2 | 95 | 294.8 | 10.3 |
| 56 | 56.0 | 2.0 | 16 | 115.9 | 4.0 | 76 | 175.9 | 6.1 | 36 | 235.9 | 8.2 | 96 | 295.8 | 10.3 |
| 57 | 57.0 | 2.0 | 17 | 116.9 | 4.1 | 77 | 176.9 | 6.2 | 37 | 236.9 | 8.3 | 97 | 296.8 | 10.4 |
| 58 | 58.0 | 2.0 | 18 | 117.9 | 4.1 | 78 | 177.9 | 6.2 | 38 | 237.9 | 8.3 | 98 | 297.8 | 10.4 |
| 59 | 59.0 | 2.1 | 19 | 118.9 | 4.2 | 79 | 178.9 | 6.2 | 39 | 238.9 | 8.3 | 99 | 298.8 | 10.4 |
| 60 | 60.0 | 2.1 | 20 | 119.9 | 4.2 | 80 | 179.9 | 6.3 | 40 | 239.9 | 8.4 | 300 | 299.8 | 10.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 88 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 3°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.1 | 61 | 60.9 | 3.2 | 121 | 120.8 | 6.3 | 181 | 180.8 | 9.5 | 241 | 240.7 | 12.6 |
| 2 | 2.0 | 0.1 | 62 | 61.9 | 3.2 | 22 | 121.8 | 6.4 | 82 | 181.8 | 9.5 | 42 | 241.7 | 12.7 |
| 3 | 3.0 | 0.2 | 63 | 62.9 | 3.3 | 23 | 122.8 | 6.4 | 83 | 182.7 | 9.6 | 43 | 242.7 | 12.7 |
| 4 | 4.0 | 0.2 | 64 | 63.9 | 3.3 | 24 | 123.8 | 6.5 | 84 | 183.7 | 9.6 | 44 | 243.7 | 12.8 |
| 5 | 5.0 | 0.3 | 65 | 64.9 | 3.4 | 25 | 124.8 | 6.5 | 85 | 184.7 | 9.7 | 45 | 244.7 | 12.8 |
| 6 | 6.0 | 0.3 | 66 | 65.9 | 3.5 | 26 | 125.8 | 6.6 | 86 | 185.7 | 9.7 | 46 | 245.7 | 12.9 |
| 7 | 7.0 | 0.4 | 67 | 66.9 | 3.5 | 27 | 126.8 | 6.6 | 87 | 186.7 | 9.8 | 47 | 246.7 | 12.9 |
| 8 | 8.0 | 0.4 | 68 | 67.9 | 3.6 | 28 | 127.8 | 6.7 | 88 | 187.7 | 9.8 | 48 | 247.7 | 13.0 |
| 9 | 9.0 | 0.5 | 69 | 68.9 | 3.6 | 29 | 128.8 | 6.8 | 89 | 188.7 | 9.9 | 49 | 248.7 | 13.0 |
| 10 | 10.0 | 0.5 | 70 | 69.9 | 3.7 | 30 | 129.8 | 6.8 | 90 | 189.7 | 9.9 | 50 | 249.7 | 13.1 |
| 11 | 11.0 | 0.6 | 71 | 70.9 | 3.7 | 31 | 130.8 | 6.9 | 191 | 190.7 | 10.0 | 251 | 250.7 | 13.1 |
| 12 | 12.0 | 0.6 | 72 | 71.9 | 3.8 | 32 | 131.8 | 6.9 | 92 | 191.7 | 10.0 | 52 | 251.7 | 13.2 |
| 13 | 13.0 | 0.7 | 73 | 72.9 | 3.8 | 33 | 132.8 | 7.0 | 93 | 192.7 | 10.1 | 53 | 252.7 | 13.2 |
| 14 | 14.0 | 0.7 | 74 | 73.9 | 3.9 | 34 | 133.8 | 7.0 | 94 | 193.7 | 10.2 | 54 | 253.7 | 13.3 |
| 15 | 15.0 | 0.8 | 75 | 74.9 | 3.9 | 35 | 134.8 | 7.1 | 95 | 194.7 | 10.2 | 55 | 254.7 | 13.3 |
| 16 | 16.0 | 0.8 | 76 | 75.9 | 4.0 | 36 | 135.8 | 7.1 | 96 | 195.7 | 10.3 | 56 | 255.6 | 13.4 |
| 17 | 17.0 | 0.9 | 77 | 76.9 | 4.0 | 37 | 136.8 | 7.2 | 97 | 196.7 | 10.3 | 57 | 256.6 | 13.5 |
| 18 | 18.0 | 0.9 | 78 | 77.9 | 4.1 | 38 | 137.8 | 7.2 | 98 | 197.7 | 10.4 | 58 | 257.6 | 13.5 |
| 19 | 19.0 | 1.0 | 79 | 78.9 | 4.1 | 39 | 138.8 | 7.3 | 99 | 198.7 | 10.4 | 59 | 258.6 | 13.6 |
| 20 | 20.0 | 1.0 | 80 | 79.9 | 4.2 | 40 | 139.8 | 7.3 | 200 | 199.7 | 10.5 | 60 | 259.6 | 13.6 |
| 21 | 21.0 | 1.1 | 81 | 80.9 | 4.2 | 141 | 140.8 | 7.4 | 201 | 200.7 | 10.5 | 261 | 260.6 | 13.7 |
| 22 | 22.0 | 1.2 | 82 | 81.9 | 4.3 | 42 | 141.8 | 7.4 | 02 | 201.7 | 10.6 | 62 | 261.6 | 13.7 |
| 23 | 23.0 | 1.2 | 83 | 82.9 | 4.3 | 43 | 142.8 | 7.5 | 03 | 202.7 | 10.6 | 63 | 262.6 | 13.8 |
| 24 | 24.0 | 1.3 | 84 | 83.9 | 4.4 | 44 | 143.8 | 7.5 | 04 | 203.7 | 10.7 | 64 | 263.6 | 13.8 |
| 25 | 25.0 | 1.3 | 85 | 84.9 | 4.4 | 45 | 144.8 | 7.6 | 05 | 204.7 | 10.7 | 65 | 264.6 | 13.9 |
| 26 | 26.0 | 1.4 | 86 | 85.9 | 4.5 | 46 | 145.8 | 7.6 | 06 | 205.7 | 10.8 | 66 | 265.6 | 13.9 |
| 27 | 27.0 | 1.4 | 87 | 86.9 | 4.6 | 47 | 146.8 | 7.7 | 07 | 206.7 | 10.8 | 67 | 266.6 | 14.0 |
| 28 | 28.0 | 1.5 | 88 | 87.9 | 4.6 | 48 | 147.8 | 7.7 | 08 | 207.7 | 10.9 | 68 | 267.6 | 14.0 |
| 29 | 29.0 | 1.5 | 89 | 88.9 | 4.7 | 49 | 148.8 | 7.8 | 09 | 208.7 | 10.9 | 69 | 268.6 | 14.1 |
| 30 | 30.0 | 1.6 | 90 | 89.9 | 4.7 | 50 | 149.8 | 7.9 | 10 | 209.7 | 11.0 | 70 | 269.6 | 14.1 |
| 31 | 31.0 | 1.6 | 91 | 90.9 | 4.8 | 151 | 150.8 | 7.9 | 211 | 210.7 | 11.0 | 271 | 270.6 | 14.2 |
| 32 | 32.0 | 1.7 | 92 | 91.9 | 4.8 | 52 | 151.8 | 8.0 | 12 | 211.7 | 11.1 | 72 | 271.6 | 14.2 |
| 33 | 33.0 | 1.7 | 93 | 92.9 | 4.9 | 53 | 152.8 | 8.0 | 13 | 212.7 | 11.1 | 73 | 272.6 | 14.3 |
| 34 | 34.0 | 1.8 | 94 | 93.9 | 4.9 | 54 | 153.8 | 8.1 | 14 | 213.7 | 11.2 | 74 | 273.6 | 14.3 |
| 35 | 35.0 | 1.8 | 95 | 94.9 | 5.0 | 55 | 154.8 | 8.1 | 15 | 214.7 | 11.3 | 75 | 274.6 | 14.4 |
| 36 | 36.0 | 1.9 | 96 | 95.9 | 5.0 | 56 | 155.8 | 8.2 | 16 | 215.7 | 11.3 | 76 | 275.6 | 14.4 |
| 37 | 36.9 | 1.9 | 97 | 96.9 | 5.1 | 57 | 156.8 | 8.2 | 17 | 216.7 | 11.4 | 77 | 276.6 | 14.5 |
| 38 | 37.9 | 2.0 | 98 | 97.9 | 5.1 | 58 | 157.8 | 8.3 | 18 | 217.7 | 11.4 | 78 | 277.6 | 14.5 |
| 39 | 38.9 | 2.0 | 99 | 98.9 | 5.2 | 59 | 158.8 | 8.3 | 19 | 218.7 | 11.5 | 79 | 278.6 | 14.6 |
| 40 | 39.9 | 2.1 | 100 | 99.9 | 5.2 | 60 | 159.8 | 8.4 | 20 | 219.7 | 11.5 | 80 | 279.6 | 14.7 |
| 41 | 40.9 | 2.1 | 101 | 100.9 | 5.3 | 161 | 160.8 | 8.4 | 221 | 220.7 | 11.6 | 281 | 280.6 | 14.7 |
| 42 | 41.9 | 2.2 | 02 | 101.9 | 5.3 | 62 | 161.8 | 8.5 | 22 | 221.7 | 11.6 | 82 | 281.6 | 14.8 |
| 43 | 42.9 | 2.3 | 03 | 102.9 | 5.4 | 63 | 162.8 | 8.5 | 23 | 222.7 | 11.7 | 83 | 282.6 | 14.8 |
| 44 | 43.9 | 2.3 | 04 | 103.9 | 5.4 | 64 | 163.8 | 8.6 | 24 | 223.7 | 11.7 | 84 | 283.6 | 14.9 |
| 45 | 44.9 | 2.4 | 05 | 104.9 | 5.5 | 65 | 164.8 | 8.6 | 25 | 224.7 | 11.8 | 85 | 284.6 | 14.9 |
| 46 | 45.9 | 2.4 | 06 | 105.9 | 5.5 | 66 | 165.8 | 8.7 | 26 | 225.7 | 11.8 | 86 | 285.6 | 15.0 |
| 47 | 46.9 | 2.5 | 07 | 106.9 | 5.6 | 67 | 166.8 | 8.7 | 27 | 226.7 | 11.9 | 87 | 286.6 | 15.0 |
| 48 | 47.9 | 2.5 | 08 | 107.9 | 5.7 | 68 | 167.8 | 8.8 | 28 | 227.7 | 11.9 | 88 | 287.6 | 15.1 |
| 49 | 48.9 | 2.6 | 09 | 108.9 | 5.7 | 69 | 168.8 | 8.8 | 29 | 228.7 | 12.0 | 89 | 288.6 | 15.1 |
| 50 | 49.9 | 2.6 | 10 | 109.8 | 5.8 | 70 | 169.8 | 8.9 | 30 | 229.7 | 12.0 | 90 | 289.6 | 15.2 |
| 51 | 50.9 | 2.7 | 111 | 110.8 | 5.8 | 171 | 170.8 | 8.9 | 231 | 230.7 | 12.1 | 291 | 290.6 | 15.2 |
| 52 | 51.9 | 2.7 | 12 | 111.8 | 5.9 | 72 | 171.8 | 9.0 | 32 | 231.7 | 12.1 | 92 | 291.6 | 15.3 |
| 53 | 52.9 | 2.8 | 13 | 112.8 | 5.9 | 73 | 172.8 | 9.1 | 33 | 232.7 | 12.2 | 93 | 292.6 | 15.3 |
| 54 | 53.9 | 2.8 | 14 | 113.8 | 6.0 | 74 | 173.8 | 9.1 | 34 | 233.7 | 12.2 | 94 | 293.6 | 15.4 |
| 55 | 54.9 | 2.9 | 15 | 114.8 | 6.0 | 75 | 174.8 | 9.2 | 35 | 234.7 | 12.3 | 95 | 294.6 | 15.4 |
| 56 | 55.9 | 2.9 | 16 | 115.8 | 6.1 | 76 | 175.8 | 9.2 | 36 | 235.7 | 12.4 | 96 | 295.6 | 15.5 |
| 57 | 56.9 | 3.0 | 17 | 116.8 | 6.1 | 77 | 176.8 | 9.3 | 37 | 236.7 | 12.4 | 97 | 296.6 | 15.5 |
| 58 | 57.9 | 3.0 | 18 | 117.8 | 6.2 | 78 | 177.8 | 9.3 | 38 | 237.7 | 12.5 | 98 | 297.6 | 15.6 |
| 59 | 58.9 | 3.1 | 19 | 118.8 | 6.2 | 79 | 178.8 | 9.4 | 39 | 238.7 | 12.5 | 99 | 298.6 | 15.6 |
| 60 | 59.9 | 3.1 | 20 | 119.8 | 6.3 | 80 | 179.8 | 9.4 | 40 | 239.7 | 12.6 | 300 | 299.6 | 15.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 87 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 4°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.1 | 61 | 60.9 | 4.3 | 131 | 120.7 | 8.4 | 181 | 180.6 | 12.6 | 241 | 240.4 | 16.8 |
| 2 | 2.0 | 0.1 | 62 | 61.8 | 4.3 | 22 | 121.7 | 8.5 | 82 | 181.6 | 12.7 | 42 | 241.4 | 16.9 |
| 3 | 3.0 | 0.2 | 63 | 62.8 | 4.4 | 23 | 122.7 | 8.6 | 83 | 182.6 | 12.8 | 43 | 242.4 | 17.0 |
| 4 | 4.0 | 0.3 | 64 | 63.8 | 4.5 | 24 | 123.7 | 8.6 | 84 | 183.6 | 12.8 | 44 | 243.4 | 17.0 |
| 5 | 5.0 | 0.3 | 65 | 64.8 | 4.5 | 25 | 124.7 | 8.7 | 85 | 184.5 | 12.9 | 45 | 244.4 | 17.1 |
| 6 | 6.0 | 0.4 | 66 | 65.8 | 4.6 | 26 | 125.7 | 8.8 | 86 | 185.5 | 13.0 | 46 | 245.4 | 17.2 |
| 7 | 7.0 | 0.5 | 67 | 66.8 | 4.7 | 27 | 126.7 | 8.9 | 87 | 186.5 | 13.0 | 47 | 246.4 | 17.2 |
| 8 | 8.0 | 0.6 | 68 | 67.8 | 4.7 | 28 | 127.7 | 8.9 | 88 | 187.5 | 13.1 | 48 | 247.4 | 17.3 |
| 9 | 9.0 | 0.6 | 69 | 68.8 | 4.8 | 29 | 128.7 | 9.0 | 89 | 188.5 | 13.2 | 49 | 248.4 | 17.4 |
| 10 | 10.0 | 0.7 | 70 | 69.8 | 4.9 | 30 | 129.7 | 9.1 | 90 | 189.5 | 13.3 | 50 | 249.4 | 17.4 |
| 11 | 11.0 | 0.8 | 71 | 70.8 | 5.0 | 131 | 130.7 | 9.1 | 191 | 190.5 | 13.3 | 251 | 250.4 | 17.5 |
| 12 | 12.0 | 0.8 | 72 | 71.8 | 5.0 | 32 | 131.7 | 9.2 | 92 | 191.5 | 13.4 | 52 | 251.4 | 17.6 |
| 13 | 13.0 | 0.9 | 73 | 72.8 | 5.1 | 33 | 132.7 | 9.3 | 93 | 192.5 | 13.5 | 53 | 252.4 | 17.6 |
| 14 | 14.0 | 1.0 | 74 | 73.8 | 5.2 | 34 | 133.7 | 9.3 | 94 | 193.5 | 13.5 | 54 | 253.4 | 17.7 |
| 15 | 15.0 | 1.0 | 75 | 74.8 | 5.2 | 35 | 134.7 | 9.4 | 95 | 194.5 | 13.6 | 55 | 254.4 | 17.8 |
| 16 | 16.0 | 1.1 | 76 | 75.8 | 5.3 | 36 | 135.7 | 9.5 | 96 | 195.5 | 13.7 | 56 | 255.4 | 17.9 |
| 17 | 17.0 | 1.2 | 77 | 76.8 | 5.4 | 37 | 136.7 | 9.6 | 97 | 196.5 | 13.7 | 57 | 256.4 | 17.9 |
| 18 | 18.0 | 1.3 | 78 | 77.8 | 5.4 | 38 | 137.7 | 9.6 | 98 | 197.5 | 13.8 | 58 | 257.4 | 18.0 |
| 19 | 19.0 | 1.3 | 79 | 78.8 | 5.5 | 39 | 138.7 | 9.7 | 99 | 198.5 | 13.9 | 59 | 258.4 | 18.1 |
| 20 | 20.0 | 1.4 | 80 | 79.8 | 5.6 | 40 | 139.7 | 9.8 | 200 | 199.5 | 14.0 | 60 | 259.4 | 18.1 |
| 21 | 20.9 | 1.5 | 81 | 80.8 | 5.7 | 141 | 140.7 | 9.8 | 201 | 200.5 | 14.0 | 261 | 260.4 | 18.2 |
| 22 | 21.9 | 1.5 | 82 | 81.8 | 5.7 | 42 | 141.7 | 9.9 | 02 | 201.5 | 14.1 | 62 | 261.4 | 18.3 |
| 23 | 22.9 | 1.6 | 83 | 82.8 | 5.8 | 43 | 142.7 | 10.0 | 03 | 202.5 | 14.2 | 63 | 262.4 | 18.3 |
| 24 | 23.9 | 1.7 | 84 | 83.8 | 5.9 | 44 | 143.6 | 10.0 | 04 | 203.5 | 14.2 | 64 | 263.4 | 18.4 |
| 25 | 24.9 | 1.7 | 85 | 84.8 | 5.9 | 45 | 144.6 | 10.1 | 05 | 204.5 | 14.3 | 65 | 264.4 | 18.5 |
| 26 | 25.9 | 1.8 | 86 | 85.8 | 6.0 | 46 | 145.6 | 10.2 | 06 | 205.5 | 14.4 | 66 | 265.4 | 18.6 |
| 27 | 26.9 | 1.9 | 87 | 86.8 | 6.1 | 47 | 146.6 | 10.3 | 07 | 206.5 | 14.4 | 67 | 266.3 | 18.6 |
| 28 | 27.9 | 2.0 | 88 | 87.8 | 6.1 | 48 | 147.6 | 10.3 | 08 | 207.5 | 14.5 | 68 | 267.3 | 18.7 |
| 29 | 28.9 | 2.0 | 89 | 88.8 | 6.2 | 49 | 148.6 | 10.4 | 09 | 208.5 | 14.6 | 69 | 268.3 | 18.8 |
| 30 | 29.9 | 2.1 | 90 | 89.8 | 6.3 | 50 | 149.6 | 10.5 | 10 | 209.5 | 14.6 | 70 | 269.3 | 18.8 |
| 31 | 30.9 | 2.2 | 91 | 90.8 | 6.3 | 151 | 150.6 | 10.5 | 211 | 210.5 | 14.7 | 271 | 270.3 | 18.9 |
| 32 | 31.9 | 2.2 | 92 | 91.8 | 6.4 | 52 | 151.6 | 10.6 | 12 | 211.5 | 14.8 | 72 | 271.3 | 19.0 |
| 33 | 32.9 | 2.3 | 93 | 92.8 | 6.5 | 53 | 152.6 | 10.7 | 13 | 212.5 | 14.9 | 73 | 272.3 | 19.0 |
| 34 | 33.9 | 2.4 | 94 | 93.8 | 6.6 | 54 | 153.6 | 10.7 | 14 | 213.5 | 14.9 | 74 | 273.3 | 19.1 |
| 35 | 34.9 | 2.4 | 95 | 94.8 | 6.6 | 55 | 154.6 | 10.8 | 15 | 214.5 | 15.0 | 75 | 274.3 | 19.2 |
| 36 | 35.9 | 2.5 | 96 | 95.8 | 6.7 | 56 | 155.6 | 10.9 | 16 | 215.5 | 15.1 | 76 | 275.3 | 19.3 |
| 37 | 36.9 | 2.6 | 97 | 96.8 | 6.8 | 57 | 156.6 | 11.0 | 17 | 216.5 | 15.1 | 77 | 276.3 | 19.3 |
| 38 | 37.9 | 2.7 | 98 | 97.8 | 6.8 | 58 | 157.6 | 11.0 | 18 | 217.5 | 15.2 | 78 | 277.3 | 19.4 |
| 39 | 38.9 | 2.7 | 99 | 98.8 | 6.9 | 59 | 158.6 | 11.1 | 19 | 218.5 | 15.3 | 79 | 278.3 | 19.5 |
| 40 | 39.9 | 2.8 | 100 | 99.8 | 7.0 | 60 | 159.6 | 11.2 | 20 | 219.5 | 15.3 | 80 | 279.3 | 19.5 |
| 41 | 40.9 | 2.9 | 101 | 100.8 | 7.0 | 161 | 160.6 | 11.2 | 221 | 220.5 | 15.4 | 281 | 280.3 | 19.6 |
| 42 | 41.9 | 2.9 | 02 | 101.8 | 7.1 | 62 | 161.6 | 11.3 | 23 | 221.5 | 15.5 | 82 | 281.3 | 19.7 |
| 43 | 42.9 | 3.0 | 03 | 102.7 | 7.2 | 63 | 162.6 | 11.4 | 24 | 222.5 | 15.6 | 83 | 282.3 | 19.7 |
| 44 | 43.9 | 3.1 | 04 | 103.7 | 7.3 | 64 | 163.6 | 11.4 | 25 | 223.5 | 15.6 | 84 | 283.3 | 19.8 |
| 45 | 44.9 | 3.1 | 05 | 104.7 | 7.3 | 65 | 164.6 | 11.5 | 26 | 224.5 | 15.7 | 85 | 284.3 | 19.9 |
| 46 | 45.9 | 3.2 | 06 | 105.7 | 7.4 | 66 | 165.6 | 11.6 | 27 | 225.4 | 15.8 | 86 | 285.3 | 20.0 |
| 47 | 46.9 | 3.3 | 07 | 106.7 | 7.5 | 67 | 166.6 | 11.6 | 28 | 226.4 | 15.8 | 87 | 286.3 | 20.1 |
| 48 | 47.9 | 3.3 | 08 | 107.6 | 7.5 | 68 | 167.6 | 11.7 | 29 | 227.4 | 15.9 | 88 | 287.3 | 20.1 |
| 49 | 48.9 | 3.4 | 09 | 108.7 | 7.6 | 69 | 168.6 | 11.8 | 30 | 228.4 | 16.0 | 89 | 288.3 | 20.2 |
| 50 | 49.9 | 3.5 | 10 | 109.7 | 7.7 | 70 | 169.6 | 11.9 | 31 | 229.4 | 16.0 | 90 | 289.3 | 20.2 |
| 51 | 50.9 | 3.6 | 111 | 110.7 | 7.7 | 171 | 170.6 | 11.9 | 231 | 230.4 | 16.1 | 291 | 290.3 | 20.3 |
| 52 | 51.9 | 3.6 | 12 | 111.7 | 7.8 | 72 | 171.6 | 12.0 | 32 | 231.4 | 16.2 | 92 | 291.3 | 20.4 |
| 53 | 52.9 | 3.7 | 13 | 112.7 | 7.9 | 73 | 172.6 | 12.1 | 33 | 232.4 | 16.3 | 93 | 292.3 | 20.4 |
| 54 | 53.9 | 3.8 | 14 | 113.7 | 8.0 | 74 | 173.6 | 12.1 | 34 | 233.4 | 16.3 | 94 | 293.3 | 20.5 |
| 55 | 54.9 | 3.8 | 15 | 114.7 | 8.0 | 75 | 174.6 | 12.2 | 35 | 234.4 | 16.4 | 95 | 294.3 | 20.6 |
| 56 | 55.9 | 3.9 | 16 | 115.7 | 8.1 | 76 | 175.6 | 12.3 | 36 | 235.4 | 16.5 | 96 | 295.3 | 20.6 |
| 57 | 56.9 | 4.0 | 17 | 116.7 | 8.2 | 77 | 176.6 | 12.3 | 37 | 236.4 | 16.5 | 97 | 296.3 | 20.7 |
| 58 | 57.9 | 4.0 | 18 | 117.7 | 8.2 | 78 | 177.6 | 12.4 | 38 | 237.4 | 16.6 | 98 | 297.3 | 20.8 |
| 59 | 58.9 | 4.1 | 19 | 118.7 | 8.3 | 79 | 178.6 | 12.5 | 39 | 238.4 | 16.7 | 99 | 298.3 | 20.9 |
| 60 | 59.9 | 4.2 | 20 | 119.7 | 8.4 | 80 | 179.6 | 12.6 | 40 | 239.4 | 16.7 | 300 | 299.3 | 20.9 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 86 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 5°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.1 | 61 | 60.8 | 5.3 | 121 | 120.5 | 10.5 | 181 | 180.3 | 15.8 | 241 | 240.1 | 21.0 |
| 2 | 2.0 | 0.2 | 62 | 61.8 | 5.4 | 22 | 121.5 | 10.6 | 82 | 181.3 | 15.9 | 42 | 241.1 | 21.1 |
| 3 | 3.0 | 0.3 | 63 | 62.8 | 5.5 | 23 | 122.5 | 10.7 | 83 | 182.3 | 15.9 | 43 | 242.1 | 21.2 |
| 4 | 4.0 | 0.3 | 64 | 63.8 | 5.6 | 24 | 123.5 | 10.8 | 84 | 183.3 | 16.0 | 44 | 243.1 | 21.3 |
| 5 | 5.0 | 0.4 | 65 | 64.8 | 5.7 | 25 | 124.5 | 10.9 | 85 | 184.3 | 16.1 | 45 | 244.1 | 21.4 |
| 6 | 6.0 | 0.5 | 66 | 65.7 | 5.8 | 26 | 125.5 | 11.0 | 86 | 185.3 | 16.2 | 46 | 245.1 | 21.4 |
| 7 | 7.0 | 0.6 | 67 | 66.7 | 5.8 | 27 | 126.5 | 11.1 | 87 | 186.3 | 16.3 | 47 | 246.1 | 21.5 |
| 8 | 8.0 | 0.7 | 68 | 67.7 | 5.9 | 28 | 127.5 | 11.2 | 88 | 187.3 | 16.4 | 48 | 247.1 | 21.6 |
| 9 | 9.0 | 0.8 | 69 | 68.7 | 6.0 | 29 | 128.5 | 11.2 | 89 | 188.3 | 16.5 | 49 | 248.1 | 21.7 |
| 10 | 10.0 | 0.9 | 70 | 69.7 | 6.1 | 30 | 129.5 | 11.3 | 90 | 189.3 | 16.6 | 50 | 249.0 | 21.8 |
| 11 | 11.0 | 1.0 | 71 | 70.7 | 6.2 | 131 | 130.5 | 11.4 | 191 | 190.3 | 16.6 | 251 | 250.0 | 21.9 |
| 12 | 12.0 | 1.0 | 72 | 71.7 | 6.3 | 32 | 131.5 | 11.5 | 92 | 191.3 | 16.7 | 52 | 251.0 | 22.0 |
| 13 | 13.0 | 1.1 | 73 | 72.7 | 6.4 | 33 | 132.5 | 11.6 | 93 | 192.3 | 16.8 | 53 | 252.0 | 22.1 |
| 14 | 13.9 | 1.2 | 74 | 73.7 | 6.4 | 34 | 133.5 | 11.7 | 94 | 193.3 | 16.9 | 54 | 253.0 | 22.1 |
| 15 | 14.9 | 1.3 | 75 | 74.7 | 6.5 | 35 | 134.5 | 11.8 | 95 | 194.3 | 17.0 | 55 | 254.0 | 22.2 |
| 16 | 15.9 | 1.4 | 76 | 75.7 | 6.6 | 36 | 135.5 | 11.9 | 96 | 195.3 | 17.1 | 56 | 255.0 | 22.3 |
| 17 | 16.9 | 1.5 | 77 | 76.7 | 6.7 | 37 | 136.5 | 11.9 | 97 | 196.3 | 17.2 | 57 | 256.0 | 22.4 |
| 18 | 17.9 | 1.6 | 78 | 77.7 | 6.8 | 38 | 137.5 | 12.0 | 98 | 197.2 | 17.3 | 58 | 257.0 | 22.5 |
| 19 | 18.9 | 1.7 | 79 | 78.7 | 6.9 | 39 | 138.5 | 12.1 | 99 | 198.2 | 17.3 | 59 | 258.0 | 22.6 |
| 20 | 19.9 | 1.7 | 80 | 79.7 | 7.0 | 40 | 139.5 | 12.2 | 200 | 199.2 | 17.4 | 60 | 259.0 | 22.7 |
| 21 | 20.9 | 1.8 | 81 | 80.7 | 7.1 | 141 | 140.5 | 12.3 | 201 | 200.2 | 17.5 | 261 | 260.0 | 22.7 |
| 22 | 21.9 | 1.9 | 82 | 81.7 | 7.1 | 42 | 141.5 | 12.4 | 02 | 201.2 | 17.6 | 62 | 261.0 | 22.8 |
| 23 | 22.9 | 2.0 | 83 | 82.7 | 7.2 | 43 | 142.5 | 12.5 | 03 | 202.2 | 17.7 | 63 | 262.0 | 22.9 |
| 24 | 23.9 | 2.1 | 84 | 83.7 | 7.3 | 44 | 143.5 | 12.6 | 04 | 203.2 | 17.8 | 64 | 263.0 | 23.0 |
| 25 | 24.9 | 2.2 | 85 | 84.7 | 7.4 | 45 | 144.4 | 12.6 | 05 | 204.2 | 17.9 | 65 | 264.0 | 23.1 |
| 26 | 25.9 | 2.3 | 86 | 85.7 | 7.5 | 46 | 145.4 | 12.7 | 06 | 205.2 | 18.0 | 66 | 265.0 | 23.2 |
| 27 | 26.9 | 2.4 | 87 | 86.7 | 7.6 | 47 | 146.4 | 12.8 | 07 | 206.2 | 18.0 | 67 | 266.0 | 23.3 |
| 28 | 27.9 | 2.4 | 88 | 87.7 | 7.7 | 48 | 147.4 | 12.9 | 08 | 207.2 | 18.1 | 68 | 267.0 | 23.4 |
| 29 | 28.9 | 2.5 | 89 | 88.7 | 7.8 | 49 | 148.4 | 13.0 | 09 | 208.2 | 18.2 | 69 | 268.0 | 23.4 |
| 30 | 29.9 | 2.6 | 90 | 89.7 | 7.8 | 50 | 149.4 | 13.1 | 10 | 209.2 | 18.3 | 70 | 269.0 | 23.5 |
| 31 | 30.9 | 2.7 | 91 | 90.7 | 7.9 | 151 | 150.4 | 13.2 | 211 | 210.2 | 18.4 | 271 | 270.0 | 23.6 |
| 32 | 31.9 | 2.8 | 92 | 91.6 | 8.0 | 52 | 151.4 | 13.2 | 12 | 211.2 | 18.5 | 72 | 271.0 | 23.7 |
| 33 | 32.9 | 2.9 | 93 | 92.6 | 8.1 | 53 | 152.4 | 13.3 | 13 | 212.2 | 18.6 | 73 | 272.0 | 23.8 |
| 34 | 33.9 | 3.0 | 94 | 93.6 | 8.2 | 54 | 153.4 | 13.4 | 14 | 213.2 | 18.7 | 74 | 273.0 | 23.9 |
| 35 | 34.9 | 3.1 | 95 | 94.6 | 8.3 | 55 | 154.4 | 13.5 | 15 | 214.2 | 18.7 | 75 | 274.0 | 24.0 |
| 36 | 35.9 | 3.1 | 96 | 95.6 | 8.4 | 56 | 155.4 | 13.6 | 16 | 215.2 | 18.8 | 76 | 274.9 | 24.1 |
| 37 | 36.9 | 3.2 | 97 | 96.6 | 8.5 | 57 | 156.4 | 13.7 | 17 | 216.2 | 18.9 | 77 | 275.9 | 24.1 |
| 38 | 37.9 | 3.3 | 98 | 97.6 | 8.5 | 58 | 157.4 | 13.8 | 18 | 217.2 | 19.0 | 78 | 276.9 | 24.2 |
| 39 | 38.9 | 3.4 | 99 | 98.6 | 8.6 | 59 | 158.4 | 13.9 | 19 | 218.2 | 19.1 | 79 | 277.9 | 24.3 |
| 40 | 39.8 | 3.5 | 100 | 99.6 | 8.7 | 60 | 159.4 | 13.9 | 20 | 219.2 | 19.2 | 80 | 278.9 | 24.4 |
| 41 | 40.8 | 3.6 | 101 | 100.6 | 8.8 | 161 | 160.4 | 14.0 | 221 | 220.2 | 19.3 | 281 | 279.9 | 24.5 |
| 42 | 41.8 | 3.7 | 02 | 101.6 | 8.9 | 62 | 161.4 | 14.1 | 22 | 221.2 | 19.3 | 82 | 280.9 | 24.6 |
| 43 | 42.8 | 3.7 | 03 | 102.6 | 9.0 | 63 | 162.4 | 14.2 | 23 | 222.2 | 19.4 | 83 | 281.9 | 24.7 |
| 44 | 43.8 | 3.8 | 04 | 103.6 | 9.1 | 64 | 163.4 | 14.3 | 24 | 223.1 | 19.5 | 84 | 282.9 | 24.8 |
| 45 | 44.8 | 3.9 | 05 | 104.6 | 9.2 | 65 | 164.4 | 14.4 | 25 | 224.1 | 19.6 | 85 | 283.9 | 24.8 |
| 46 | 45.8 | 4.0 | 06 | 105.6 | 9.2 | 66 | 165.4 | 14.5 | 26 | 225.1 | 19.7 | 86 | 284.9 | 24.9 |
| 47 | 46.8 | 4.1 | 07 | 106.6 | 9.3 | 67 | 166.4 | 14.6 | 27 | 226.1 | 19.8 | 87 | 285.9 | 25.0 |
| 48 | 47.8 | 4.2 | 08 | 107.6 | 9.4 | 68 | 167.4 | 14.6 | 28 | 227.1 | 19.9 | 88 | 286.9 | 25.1 |
| 49 | 48.8 | 4.3 | 09 | 108.6 | 9.5 | 69 | 168.4 | 14.7 | 29 | 228.1 | 20.0 | 89 | 287.9 | 25.2 |
| 50 | 49.8 | 4.4 | 10 | 109.6 | 9.6 | 70 | 169.4 | 14.8 | 30 | 229.1 | 20.0 | 90 | 288.9 | 25.3 |
| 51 | 50.8 | 4.4 | 111 | 110.6 | 9.7 | 171 | 170.3 | 14.9 | 231 | 230.1 | 20.1 | 291 | 289.9 | 25.4 |
| 52 | 51.8 | 4.5 | 12 | 111.6 | 9.8 | 72 | 171.3 | 15.0 | 32 | 231.1 | 20.2 | 92 | 290.9 | 25.4 |
| 53 | 52.8 | 4.6 | 13 | 112.6 | 9.8 | 73 | 172.3 | 15.1 | 33 | 232.1 | 20.3 | 93 | 291.9 | 25.5 |
| 54 | 53.8 | 4.7 | 14 | 113.6 | 9.9 | 74 | 173.3 | 15.2 | 34 | 233.1 | 20.4 | 94 | 292.9 | 25.6 |
| 55 | 54.8 | 4.8 | 15 | 114.6 | 10.0 | 75 | 174.3 | 15.3 | 35 | 234.1 | 20.5 | 95 | 293.9 | 25.7 |
| 56 | 55.8 | 4.9 | 16 | 115.6 | 10.1 | 76 | 175.3 | 15.3 | 36 | 235.1 | 20.6 | 96 | 294.9 | 25.8 |
| 57 | 56.8 | 5.0 | 17 | 116.6 | 10.2 | 77 | 176.3 | 15.4 | 37 | 236.1 | 20.7 | 97 | 295.9 | 25.9 |
| 58 | 57.8 | 5.1 | 18 | 117.6 | 10.3 | 78 | 177.3 | 15.5 | 38 | 237.1 | 20.7 | 98 | 296.9 | 26.0 |
| 59 | 58.8 | 5.1 | 19 | 118.5 | 10.4 | 79 | 178.3 | 15.6 | 39 | 238.1 | 20.8 | 99 | 297.9 | 26.1 |
| 60 | 59.8 | 5.2 | 20 | 119.5 | 10.5 | 80 | 179.3 | 15.7 | 40 | 239.1 | 20.9 | 300 | 298.9 | 26.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 85 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 6°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.1 | 61 | 60.7 | 6.4 | 121 | 120.3 | 12.6 | 181 | 180.0 | 18.9 | 241 | 239.7 | 25.2 |
| 2 | 2.0 | 0.2 | 62 | 61.7 | 6.5 | 22 | 121.3 | 12.8 | 82 | 181.0 | 19.0 | 42 | 240.7 | 25.3 |
| 3 | 3.0 | 0.3 | 63 | 62.7 | 6.6 | 23 | 122.3 | 12.9 | 83 | 182.0 | 19.1 | 43 | 241.7 | 25.4 |
| 4 | 4.0 | 0.4 | 64 | 63.6 | 6.7 | 24 | 123.3 | 13.0 | 84 | 183.0 | 19.2 | 44 | 242.7 | 25.5 |
| 5 | 5.0 | 0.5 | 65 | 64.6 | 6.8 | 25 | 124.3 | 13.1 | 85 | 184.0 | 19.3 | 45 | 243.7 | 25.6 |
| 6 | 6.0 | 0.6 | 66 | 65.6 | 6.9 | 26 | 125.3 | 13.2 | 86 | 185.0 | 19.4 | 46 | 244.7 | 25.7 |
| 7 | 7.0 | 0.7 | 67 | 66.6 | 7.0 | 27 | 126.3 | 13.3 | 87 | 186.0 | 19.5 | 47 | 245.6 | 25.8 |
| 8 | 8.0 | 0.8 | 68 | 67.6 | 7.1 | 28 | 127.3 | 13.4 | 88 | 187.0 | 19.7 | 48 | 246.6 | 25.9 |
| 9 | 9.0 | 0.9 | 69 | 68.6 | 7.2 | 29 | 128.3 | 13.5 | 89 | 188.0 | 19.8 | 49 | 247.6 | 26.0 |
| 10 | 9.9 | 1.0 | 70 | 69.6 | 7.3 | 30 | 129.3 | 13.6 | 90 | 189.0 | 19.9 | 50 | 248.6 | 26.1 |
| 11 | 10.9 | 1.1 | 71 | 70.6 | 7.4 | 131 | 130.3 | 13.7 | 191 | 190.0 | 20.0 | 251 | 249.6 | 26.2 |
| 12 | 11.9 | 1.3 | 72 | 71.6 | 7.5 | 32 | 131.3 | 13.8 | 92 | 190.9 | 20.1 | 52 | 250.6 | 26.3 |
| 13 | 12.9 | 1.4 | 73 | 72.6 | 7.6 | 33 | 132.3 | 13.9 | 93 | 191.9 | 20.2 | 53 | 251.6 | 26.4 |
| 14 | 13.9 | 1.5 | 74 | 73.6 | 7.7 | 34 | 133.3 | 14.0 | 94 | 192.9 | 20.3 | 54 | 252.6 | 26.6 |
| 15 | 14.9 | 1.6 | 75 | 74.6 | 7.8 | 35 | 134.3 | 14.1 | 95 | 193.9 | 20.4 | 55 | 253.6 | 26.7 |
| 16 | 15.9 | 1.7 | 76 | 75.6 | 7.9 | 36 | 135.3 | 14.2 | 96 | 194.9 | 20.5 | 56 | 254.6 | 26.8 |
| 17 | 16.9 | 1.8 | 77 | 76.6 | 8.0 | 37 | 136.2 | 14.3 | 97 | 195.9 | 20.6 | 57 | 255.6 | 26.9 |
| 18 | 17.9 | 1.9 | 78 | 77.6 | 8.2 | 38 | 137.2 | 14.4 | 98 | 196.9 | 20.7 | 58 | 256.6 | 27.0 |
| 19 | 18.9 | 2.0 | 79 | 78.6 | 8.3 | 39 | 138.2 | 14.5 | 99 | 197.9 | 20.8 | 59 | 257.6 | 27.1 |
| 20 | 19.9 | 2.1 | 80 | 79.6 | 8.4 | 40 | 139.2 | 14.6 | 200 | 198.9 | 20.9 | 60 | 258.6 | 27.2 |
| 21 | 20.9 | 2.2 | 81 | 80.6 | 8.5 | 141 | 140.2 | 14.7 | 201 | 199.9 | 21.0 | 261 | 259.6 | 27.3 |
| 22 | 21.9 | 2.3 | 82 | 81.6 | 8.6 | 42 | 141.2 | 14.8 | 02 | 200.9 | 21.1 | 62 | 260.6 | 27.4 |
| 23 | 22.9 | 2.4 | 83 | 82.5 | 8.7 | 43 | 142.2 | 14.9 | 03 | 201.9 | 21.2 | 63 | 261.6 | 27.5 |
| 24 | 23.9 | 2.5 | 84 | 83.5 | 8.8 | 44 | 143.2 | 15.1 | 04 | 202.9 | 21.3 | 64 | 262.6 | 27.6 |
| 25 | 24.9 | 2.6 | 85 | 84.5 | 8.9 | 45 | 144.2 | 15.2 | 05 | 203.9 | 21.4 | 65 | 263.5 | 27.7 |
| 26 | 25.9 | 2.7 | 86 | 85.5 | 9.0 | 46 | 145.2 | 15.3 | 06 | 204.9 | 21.5 | 66 | 264.5 | 27.8 |
| 27 | 26.9 | 2.8 | 87 | 86.5 | 9.1 | 47 | 146.2 | 15.4 | 07 | 205.9 | 21.6 | 67 | 265.5 | 27.9 |
| 28 | 27.8 | 2.9 | 88 | 87.5 | 9.2 | 48 | 147.2 | 15.5 | 08 | 206.9 | 21.7 | 68 | 266.5 | 28.0 |
| 29 | 28.8 | 3.0 | 89 | 88.5 | 9.3 | 49 | 148.2 | 15.6 | 09 | 207.9 | 21.8 | 69 | 267.5 | 28.1 |
| 30 | 29.8 | 3.1 | 90 | 89.5 | 9.4 | 50 | 149.2 | 15.7 | 10 | 208.8 | 22.0 | 70 | 268.5 | 28.2 |
| 31 | 30.8 | 3.2 | 91 | 90.5 | 9.5 | 151 | 150.2 | 15.8 | 211 | 209.8 | 22.1 | 271 | 269.5 | 28.3 |
| 32 | 31.8 | 3.3 | 92 | 91.5 | 9.6 | 52 | 151.2 | 15.9 | 12 | 210.8 | 22.2 | 72 | 270.5 | 28.4 |
| 33 | 32.8 | 3.4 | 93 | 92.5 | 9.7 | 53 | 152.2 | 16.0 | 13 | 211.8 | 22.3 | 73 | 271.5 | 28.5 |
| 34 | 33.8 | 3.6 | 94 | 93.5 | 9.8 | 54 | 153.2 | 16.1 | 14 | 212.8 | 22.4 | 74 | 272.5 | 28.6 |
| 35 | 34.8 | 3.7 | 95 | 94.5 | 9.9 | 55 | 154.2 | 16.2 | 15 | 213.8 | 22.5 | 75 | 273.5 | 28.7 |
| 36 | 35.8 | 3.8 | 96 | 95.5 | 10.0 | 56 | 155.1 | 16.3 | 16 | 214.8 | 22.6 | 76 | 274.5 | 28.8 |
| 37 | 36.8 | 3.9 | 97 | 96.5 | 10.1 | 57 | 156.1 | 16.4 | 17 | 215.8 | 22.7 | 77 | 275.5 | 29.0 |
| 38 | 37.8 | 4.0 | 98 | 97.5 | 10.2 | 58 | 157.1 | 16.5 | 18 | 216.8 | 22.8 | 78 | 276.5 | 29.1 |
| 39 | 38.8 | 4.1 | 99 | 98.5 | 10.3 | 59 | 158.1 | 16.6 | 19 | 217.8 | 22.9 | 79 | 277.5 | 29.2 |
| 40 | 39.8 | 4.2 | 100 | 99.5 | 10.5 | 60 | 159.1 | 16.7 | 20 | 218.8 | 23.0 | 80 | 278.5 | 29.3 |
| 41 | 40.8 | 4.3 | 101 | 100.4 | 10.6 | 161 | 160.1 | 16.8 | 221 | 219.8 | 23.1 | 281 | 279.5 | 29.4 |
| 42 | 41.8 | 4.4 | 02 | 101.4 | 10.7 | 62 | 161.1 | 16.9 | 22 | 220.8 | 23.2 | 82 | 280.5 | 29.5 |
| 43 | 42.8 | 4.5 | 03 | 102.4 | 10.8 | 63 | 162.1 | 17.0 | 23 | 221.8 | 23.3 | 83 | 281.4 | 29.6 |
| 44 | 43.8 | 4.6 | 04 | 103.4 | 10.9 | 64 | 163.1 | 17.1 | 24 | 222.8 | 23.4 | 84 | 282.4 | 29.7 |
| 45 | 44.8 | 4.7 | 05 | 104.4 | 11.0 | 65 | 164.1 | 17.2 | 25 | 223.8 | 23.5 | 85 | 283.4 | 29.8 |
| 46 | 45.7 | 4.8 | 06 | 105.4 | 11.1 | 66 | 165.1 | 17.4 | 26 | 224.8 | 23.6 | 86 | 284.4 | 29.9 |
| 47 | 46.7 | 4.9 | 07 | 106.4 | 11.2 | 67 | 166.1 | 17.5 | 27 | 225.8 | 23.7 | 87 | 285.4 | 30.0 |
| 48 | 47.7 | 5.0 | 08 | 107.4 | 11.3 | 68 | 167.1 | 17.6 | 28 | 226.8 | 23.8 | 88 | 286.4 | 30.1 |
| 49 | 48.7 | 5.1 | 09 | 108.4 | 11.4 | 69 | 168.1 | 17.7 | 29 | 227.7 | 23.9 | 89 | 287.4 | 30.2 |
| 50 | 49.7 | 5.2 | 10 | 109.4 | 11.5 | 70 | 169.1 | 17.8 | 30 | 228.7 | 24.0 | 90 | 288.4 | 30.3 |
| 51 | 50.7 | 5.3 | 111 | 110.4 | 11.6 | 171 | 170.1 | 17.9 | 231 | 229.7 | 24.1 | 291 | 289.4 | 30.4 |
| 52 | 51.7 | 5.4 | 12 | 111.4 | 11.7 | 72 | 171.1 | 18.0 | 32 | 230.7 | 24.3 | 92 | 290.4 | 30.5 |
| 53 | 52.7 | 5.5 | 13 | 112.4 | 11.8 | 73 | 172.1 | 18.1 | 33 | 231.7 | 24.4 | 93 | 291.4 | 30.6 |
| 54 | 53.7 | 5.6 | 14 | 113.4 | 11.9 | 74 | 173.0 | 18.2 | 34 | 232.7 | 24.5 | 94 | 292.4 | 30.7 |
| 55 | 54.7 | 5.7 | 15 | 114.4 | 12.0 | 75 | 174.0 | 18.3 | 35 | 233.7 | 24.6 | 95 | 293.4 | 30.8 |
| 56 | 55.7 | 5.9 | 16 | 115.4 | 12.1 | 76 | 175.0 | 18.4 | 36 | 234.7 | 24.7 | 96 | 294.4 | 30.9 |
| 57 | 56.7 | 6.0 | 17 | 116.4 | 12.2 | 77 | 176.0 | 18.5 | 37 | 235.7 | 24.8 | 97 | 295.4 | 31.0 |
| 58 | 57.7 | 6.1 | 18 | 117.4 | 12.3 | 78 | 177.0 | 18.6 | 38 | 236.7 | 24.9 | 98 | 296.4 | 31.1 |
| 59 | 58.7 | 6.2 | 19 | 118.3 | 12.4 | 79 | 178.0 | 18.7 | 39 | 237.7 | 25.0 | 99 | 297.4 | 31.3 |
| 60 | 59.7 | 6.3 | 20 | 119.3 | 12.5 | 80 | 179.0 | 18.8 | 40 | 238.7 | 25.1 | 300 | 298.4 | 31.4 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|

[For 84 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 7°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.1 | 61 | 60.5 | 7.4 | 121 | 120.1 | 14.7 | 181 | 179.7 | 22.1 | 241 | 239.2 | 29.4 |
| 2 | 2.0 | 0.2 | 62 | 61.5 | 7.6 | 22 | 121.1 | 14.9 | 82 | 180.6 | 22.2 | 42 | 240.2 | 29.5 |
| 3 | 3.0 | 0.4 | 63 | 62.5 | 7.7 | 23 | 122.1 | 15.0 | 83 | 181.6 | 22.3 | 43 | 241.2 | 29.6 |
| 4 | 4.0 | 0.5 | 64 | 63.5 | 7.8 | 24 | 123.1 | 15.1 | 84 | 182.6 | 22.4 | 44 | 242.2 | 29.7 |
| 5 | 5.0 | 0.6 | 65 | 64.5 | 7.9 | 25 | 124.1 | 15.2 | 85 | 183.6 | 22.5 | 45 | 243.2 | 29.8 |
| 6 | 6.0 | 0.7 | 66 | 65.5 | 8.0 | 26 | 125.1 | 15.4 | 86 | 184.6 | 22.7 | 46 | 244.2 | 30.0 |
| 7 | 6.9 | 0.9 | 67 | 66.5 | 8.2 | 27 | 126.1 | 15.5 | 87 | 185.6 | 22.8 | 47 | 245.2 | 30.1 |
| 8 | 7.9 | 1.0 | 68 | 67.5 | 8.3 | 28 | 127.0 | 15.6 | 88 | 186.6 | 22.9 | 48 | 246.2 | 30.2 |
| 9 | 8.9 | 1.1 | 69 | 68.5 | 8.4 | 29 | 128.0 | 15.7 | 89 | 187.6 | 23.0 | 49 | 247.1 | 30.3 |
| 10 | 9.9 | 1.2 | 70 | 69.5 | 8.5 | 30 | 129.0 | 15.8 | 90 | 188.6 | 23.2 | 50 | 248.1 | 30.5 |
| 11 | 10.9 | 1.3 | 71 | 70.5 | 8.7 | 131 | 130.0 | 16.0 | 191 | 189.6 | 23.3 | 251 | 249.1 | 30.6 |
| 12 | 11.9 | 1.5 | 72 | 71.5 | 8.8 | 32 | 131.0 | 16.1 | 92 | 190.6 | 23.4 | 52 | 250.1 | 30.7 |
| 13 | 12.9 | 1.6 | 73 | 72.5 | 8.9 | 33 | 132.0 | 16.2 | 93 | 191.6 | 23.5 | 53 | 251.1 | 30.8 |
| 14 | 13.9 | 1.7 | 74 | 73.4 | 9.0 | 34 | 133.0 | 16.3 | 94 | 192.6 | 23.6 | 54 | 252.1 | 31.0 |
| 15 | 14.9 | 1.8 | 75 | 74.4 | 9.1 | 35 | 134.0 | 16.5 | 95 | 193.5 | 23.8 | 55 | 253.1 | 31.1 |
| 16 | 15.9 | 1.9 | 76 | 75.4 | 9.3 | 36 | 135.0 | 16.6 | 96 | 194.5 | 23.9 | 56 | 254.1 | 31.2 |
| 17 | 16.9 | 2.1 | 77 | 76.4 | 9.4 | 37 | 136.0 | 16.7 | 97 | 195.5 | 24.0 | 57 | 255.1 | 31.3 |
| 18 | 17.9 | 2.2 | 78 | 77.4 | 9.5 | 38 | 137.0 | 16.8 | 98 | 196.5 | 24.1 | 58 | 256.1 | 31.4 |
| 19 | 18.9 | 2.3 | 79 | 78.4 | 9.6 | 39 | 138.0 | 16.9 | 99 | 197.5 | 24.3 | 59 | 257.1 | 31.6 |
| 20 | 19.9 | 2.4 | 80 | 79.4 | 9.7 | 40 | 139.0 | 17.1 | 200 | 198.5 | 24.4 | 60 | 258.1 | 31.7 |
| 21 | 20.8 | 2.6 | 81 | 80.4 | 9.9 | 141 | 139.9 | 17.2 | 201 | 199.5 | 24.5 | 261 | 259.1 | 31.8 |
| 22 | 21.8 | 2.7 | 82 | 81.4 | 10.0 | 42 | 140.9 | 17.3 | 02 | 200.5 | 24.6 | 62 | 260.0 | 31.9 |
| 23 | 22.8 | 2.8 | 83 | 82.4 | 10.1 | 43 | 141.9 | 17.4 | 03 | 201.5 | 24.7 | 63 | 261.0 | 32.1 |
| 24 | 23.8 | 2.9 | 84 | 83.4 | 10.2 | 44 | 142.9 | 17.5 | 04 | 202.5 | 24.9 | 64 | 262.0 | 32.2 |
| 25 | 24.8 | 3.0 | 85 | 84.4 | 10.4 | 45 | 143.9 | 17.7 | 05 | 203.5 | 25.0 | 65 | 263.0 | 32.3 |
| 26 | 25.8 | 3.2 | 86 | 85.4 | 10.5 | 46 | 144.9 | 17.8 | 06 | 204.5 | 25.1 | 66 | 264.0 | 32.4 |
| 27 | 26.8 | 3.3 | 87 | 86.4 | 10.6 | 47 | 145.9 | 17.9 | 07 | 205.5 | 25.2 | 67 | 265.0 | 32.5 |
| 28 | 27.8 | 3.4 | 88 | 87.3 | 10.7 | 48 | 146.9 | 18.0 | 08 | 206.5 | 25.3 | 68 | 266.0 | 32.7 |
| 29 | 28.8 | 3.5 | 89 | 88.3 | 10.8 | 49 | 147.9 | 18.2 | 09 | 207.4 | 25.5 | 69 | 267.0 | 32.8 |
| 30 | 29.8 | 3.7 | 90 | 89.3 | 11.0 | 50 | 148.9 | 18.3 | 10 | 208.4 | 25.6 | 70 | 268.0 | 32.9 |
| 31 | 30.8 | 3.8 | 91 | 90.3 | 11.1 | 151 | 149.9 | 18.4 | 211 | 209.4 | 25.7 | 271 | 269.0 | 33.0 |
| 32 | 31.8 | 3.9 | 92 | 91.3 | 11.2 | 52 | 150.9 | 18.5 | 12 | 210.4 | 25.8 | 72 | 270.0 | 33.1 |
| 33 | 32.8 | 4.0 | 93 | 92.3 | 11.3 | 53 | 151.9 | 18.6 | 13 | 211.4 | 26.0 | 73 | 271.0 | 33.3 |
| 34 | 33.7 | 4.1 | 94 | 93.3 | 11.5 | 54 | 152.9 | 18.8 | 14 | 212.4 | 26.1 | 74 | 272.0 | 33.4 |
| 35 | 34.7 | 4.3 | 95 | 94.3 | 11.6 | 55 | 153.8 | 18.9 | 15 | 213.4 | 26.2 | 75 | 273.0 | 33.5 |
| 36 | 35.7 | 4.4 | 96 | 95.3 | 11.7 | 56 | 154.8 | 19.0 | 16 | 214.4 | 26.3 | 76 | 273.9 | 33.6 |
| 37 | 36.7 | 4.5 | 97 | 96.3 | 11.8 | 57 | 155.8 | 19.1 | 17 | 215.4 | 26.4 | 77 | 274.9 | 33.8 |
| 38 | 37.7 | 4.6 | 98 | 97.3 | 11.9 | 58 | 156.8 | 19.3 | 18 | 216.4 | 26.6 | 78 | 275.9 | 33.9 |
| 39 | 38.7 | 4.8 | 99 | 98.3 | 12.1 | 59 | 157.8 | 19.4 | 19 | 217.4 | 26.7 | 79 | 276.9 | 34.0 |
| 40 | 39.7 | 4.9 | 100 | 99.3 | 12.2 | 60 | 158.8 | 19.5 | 20 | 218.4 | 26.8 | 80 | 277.9 | 34.1 |
| 41 | 40.7 | 5.0 | 101 | 100.2 | 12.3 | 161 | 159.8 | 19.6 | 221 | 219.4 | 26.9 | 281 | 278.9 | 34.2 |
| 42 | 41.7 | 5.1 | 02 | 101.2 | 12.4 | 62 | 160.8 | 19.7 | 22 | 220.3 | 27.1 | 82 | 279.9 | 34.4 |
| 43 | 42.7 | 5.2 | 03 | 102.2 | 12.6 | 63 | 161.8 | 19.9 | 23 | 221.3 | 27.2 | 83 | 280.9 | 34.5 |
| 44 | 43.7 | 5.4 | 04 | 103.2 | 12.7 | 64 | 162.8 | 20.0 | 24 | 222.3 | 27.3 | 84 | 281.9 | 34.6 |
| 45 | 44.7 | 5.5 | 05 | 104.2 | 12.8 | 65 | 163.8 | 20.1 | 25 | 223.3 | 27.4 | 85 | 282.9 | 34.7 |
| 46 | 45.7 | 5.6 | 06 | 105.2 | 12.9 | 66 | 164.8 | 20.2 | 26 | 224.3 | 27.5 | 86 | 283.9 | 34.9 |
| 47 | 46.6 | 5.7 | 07 | 106.2 | 13.0 | 67 | 165.8 | 20.4 | 27 | 225.3 | 27.7 | 87 | 284.9 | 35.0 |
| 48 | 47.6 | 5.8 | 08 | 107.2 | 13.2 | 68 | 166.7 | 20.5 | 28 | 226.3 | 27.8 | 88 | 285.9 | 35.1 |
| 49 | 48.6 | 6.0 | 09 | 108.2 | 13.3 | 69 | 167.7 | 20.6 | 29 | 227.3 | 27.9 | 89 | 286.8 | 35.2 |
| 50 | 49.6 | 6.1 | 10 | 109.2 | 13.4 | 70 | 168.7 | 20.7 | 30 | 228.3 | 28.0 | 90 | 287.8 | 35.3 |
| 51 | 50.6 | 6.2 | 111 | 110.2 | 13.5 | 171 | 169.7 | 20.8 | 231 | 229.3 | 28.2 | 291 | 288.8 | 35.5 |
| 52 | 51.6 | 6.3 | 12 | 111.2 | 13.6 | 72 | 170.7 | 21.0 | 32 | 230.3 | 28.3 | 92 | 289.8 | 35.6 |
| 53 | 52.6 | 6.5 | 13 | 112.2 | 13.8 | 73 | 171.7 | 21.1 | 33 | 231.3 | 28.4 | 93 | 290.8 | 35.7 |
| 54 | 53.6 | 6.6 | 14 | 113.2 | 13.9 | 74 | 172.7 | 21.2 | 34 | 232.3 | 28.5 | 94 | 291.8 | 35.8 |
| 55 | 54.6 | 6.7 | 15 | 114.1 | 14.0 | 75 | 173.7 | 21.3 | 35 | 233.2 | 28.6 | 95 | 292.8 | 36.0 |
| 56 | 55.6 | 6.8 | 16 | 115.1 | 14.1 | 76 | 174.7 | 21.4 | 36 | 234.2 | 28.8 | 96 | 293.8 | 36.1 |
| 57 | 56.6 | 6.9 | 17 | 116.1 | 14.3 | 77 | 175.7 | 21.6 | 37 | 235.2 | 28.9 | 97 | 294.8 | 36.2 |
| 58 | 57.6 | 7.1 | 18 | 117.1 | 14.4 | 78 | 176.7 | 21.7 | 38 | 236.2 | 29.0 | 98 | 295.8 | 36.3 |
| 59 | 58.6 | 7.2 | 19 | 118.1 | 14.5 | 79 | 177.7 | 21.8 | 39 | 237.2 | 29.1 | 99 | 296.8 | 36.4 |
| 60 | 59.6 | 7.3 | 20 | 119.1 | 14.6 | 80 | 178.7 | 21.9 | 40 | 238.2 | 29.2 | 100 | 297.8 | 36.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 83 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 9°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.1 | 61 | 60.4 | 8.5 | 121 | 119.8 | 16.8 | 181 | 179.2 | 25.2 | 241 | 238.7 | 33.5 |
| 2 | 2.0 | 0.3 | 62 | 61.4 | 8.6 | 22 | 120.8 | 17.0 | 82 | 180.2 | 25.3 | 42 | 239.6 | 33.7 |
| 3 | 3.0 | 0.4 | 63 | 62.4 | 8.8 | 23 | 121.8 | 17.1 | 83 | 181.2 | 25.5 | 43 | 240.6 | 33.8 |
| 4 | 4.0 | 0.6 | 64 | 63.4 | 8.9 | 24 | 122.8 | 17.3 | 84 | 182.2 | 25.6 | 44 | 241.6 | 34.0 |
| 5 | 5.0 | 0.7 | 65 | 64.4 | 9.0 | 25 | 123.8 | 17.4 | 85 | 183.2 | 25.7 | 45 | 242.6 | 34.1 |
| 6 | 5.9 | 0.8 | 66 | 65.4 | 9.2 | 26 | 124.8 | 17.5 | 86 | 184.2 | 25.9 | 46 | 243.6 | 34.2 |
| 7 | 6.9 | 1.0 | 67 | 66.3 | 9.3 | 27 | 125.8 | 17.7 | 87 | 185.2 | 26.0 | 47 | 244.6 | 34.4 |
| 8 | 7.9 | 1.1 | 68 | 67.3 | 9.5 | 28 | 126.8 | 17.8 | 88 | 186.2 | 26.2 | 48 | 245.6 | 34.5 |
| 9 | 8.9 | 1.3 | 69 | 68.3 | 9.6 | 29 | 127.7 | 18.0 | 89 | 187.2 | 26.3 | 49 | 246.6 | 34.7 |
| 10 | 9.9 | 1.4 | 70 | 69.3 | 9.7 | 30 | 128.7 | 18.1 | 90 | 188.2 | 26.4 | 50 | 247.6 | 34.8 |
| 11 | 10.9 | 1.5 | 71 | 70.3 | 9.9 | 131 | 129.7 | 18.2 | 191 | 189.1 | 26.6 | 251 | 248.6 | 34.9 |
| 12 | 11.9 | 1.7 | 72 | 71.3 | 10.0 | 32 | 130.7 | 18.4 | 92 | 190.1 | 26.7 | 52 | 249.5 | 35.1 |
| 13 | 12.9 | 1.8 | 73 | 72.3 | 10.2 | 33 | 131.7 | 18.5 | 93 | 191.1 | 26.9 | 53 | 250.5 | 35.2 |
| 14 | 13.9 | 1.9 | 74 | 73.3 | 10.3 | 34 | 132.7 | 18.6 | 94 | 192.1 | 27.0 | 54 | 251.5 | 35.3 |
| 15 | 14.9 | 2.1 | 75 | 74.3 | 10.4 | 35 | 133.7 | 18.8 | 95 | 193.1 | 27.1 | 55 | 252.5 | 35.5 |
| 16 | 15.8 | 2.2 | 76 | 75.3 | 10.6 | 36 | 134.7 | 18.9 | 96 | 194.1 | 27.3 | 56 | 253.5 | 35.6 |
| 17 | 16.8 | 2.4 | 77 | 76.3 | 10.7 | 37 | 135.7 | 19.1 | 97 | 195.1 | 27.4 | 57 | 254.5 | 35.8 |
| 18 | 17.8 | 2.5 | 78 | 77.2 | 10.9 | 38 | 136.7 | 19.2 | 98 | 196.1 | 27.6 | 58 | 255.5 | 35.9 |
| 19 | 18.8 | 2.6 | 79 | 78.2 | 11.0 | 39 | 137.7 | 19.3 | 99 | 197.1 | 27.7 | 59 | 256.5 | 36.0 |
| 20 | 19.8 | 2.8 | 80 | 79.2 | 11.1 | 40 | 138.6 | 19.5 | 200 | 198.1 | 27.8 | 60 | 257.5 | 36.2 |
| 21 | 20.8 | 2.9 | 81 | 80.2 | 11.3 | 141 | 139.6 | 19.6 | 201 | 199.0 | 28.0 | 261 | 258.5 | 36.3 |
| 22 | 21.8 | 3.1 | 82 | 81.2 | 11.4 | 42 | 140.6 | 19.8 | 02 | 200.0 | 28.1 | 62 | 259.5 | 36.5 |
| 23 | 22.8 | 3.2 | 83 | 82.2 | 11.6 | 43 | 141.6 | 19.9 | 03 | 201.0 | 28.3 | 03 | 260.4 | 36.6 |
| 24 | 23.8 | 3.3 | 84 | 83.2 | 11.7 | 44 | 142.6 | 20.0 | 04 | 202.0 | 28.4 | 64 | 261.4 | 36.7 |
| 25 | 24.8 | 3.5 | 85 | 84.2 | 11.8 | 45 | 143.6 | 20.2 | 05 | 203.0 | 28.5 | 65 | 262.4 | 36.9 |
| 26 | 25.7 | 3.6 | 86 | 85.2 | 12.0 | 46 | 144.6 | 20.3 | 06 | 204.0 | 28.7 | 66 | 263.4 | 37.0 |
| 27 | 26.7 | 3.8 | 87 | 86.2 | 12.1 | 47 | 145.6 | 20.5 | 07 | 205.0 | 28.8 | 67 | 264.4 | 37.2 |
| 28 | 27.7 | 3.9 | 88 | 87.1 | 12.2 | 48 | 146.6 | 20.6 | 08 | 206.0 | 28.9 | 68 | 265.4 | 37.3 |
| 29 | 28.7 | 4.0 | 89 | 88.1 | 12.4 | 49 | 147.5 | 20.7 | 09 | 207.0 | 29.1 | 69 | 266.4 | 37.4 |
| 30 | 29.7 | 4.2 | 90 | 89.1 | 12.5 | 50 | 148.5 | 20.9 | 10 | 208.0 | 29.2 | 70 | 267.4 | 37.6 |
| 31 | 30.7 | 4.3 | 91 | 90.1 | 12.7 | 151 | 149.5 | 21.0 | 211 | 208.9 | 29.4 | 271 | 268.4 | 37.7 |
| 32 | 31.7 | 4.5 | 92 | 91.1 | 12.8 | 52 | 150.5 | 21.2 | 12 | 209.9 | 29.5 | 72 | 269.4 | 37.9 |
| 33 | 32.7 | 4.6 | 93 | 92.1 | 12.9 | 53 | 151.5 | 21.3 | 13 | 210.9 | 29.6 | 73 | 270.3 | 38.0 |
| 34 | 33.7 | 4.7 | 94 | 93.1 | 13.1 | 54 | 152.5 | 21.4 | 14 | 211.9 | 29.8 | 74 | 271.3 | 38.1 |
| 35 | 34.7 | 4.9 | 95 | 94.1 | 13.2 | 55 | 153.5 | 21.6 | 15 | 212.9 | 29.9 | 75 | 272.3 | 38.3 |
| 36 | 35.6 | 5.0 | 96 | 95.1 | 13.4 | 56 | 154.5 | 21.7 | 16 | 213.9 | 30.1 | 76 | 273.3 | 38.4 |
| 37 | 36.6 | 5.1 | 97 | 96.1 | 13.5 | 57 | 155.5 | 21.9 | 17 | 214.9 | 30.2 | 77 | 274.3 | 38.6 |
| 38 | 37.6 | 5.3 | 98 | 97.0 | 13.6 | 58 | 156.5 | 22.0 | 18 | 215.9 | 30.3 | 78 | 275.3 | 38.7 |
| 39 | 38.6 | 5.4 | 99 | 98.0 | 13.8 | 59 | 157.5 | 22.1 | 19 | 216.9 | 30.5 | 79 | 276.3 | 38.8 |
| 40 | 39.6 | 5.6 | 100 | 99.0 | 13.9 | 60 | 158.4 | 22.3 | 20 | 217.9 | 30.6 | 80 | 277.3 | 39.0 |
| 41 | 40.6 | 5.7 | 101 | 100.0 | 14.1 | 161 | 159.4 | 22.4 | 221 | 218.8 | 30.8 | 281 | 278.3 | 39.1 |
| 42 | 41.6 | 5.8 | 02 | 101.0 | 14.2 | 62 | 160.4 | 22.5 | 22 | 219.8 | 30.9 | 82 | 279.3 | 39.2 |
| 43 | 42.6 | 6.0 | 03 | 102.0 | 14.3 | 63 | 161.4 | 22.7 | 23 | 220.8 | 31.0 | 83 | 280.2 | 39.4 |
| 44 | 43.6 | 6.1 | 04 | 103.0 | 14.5 | 64 | 162.4 | 22.8 | 24 | 221.8 | 31.2 | 84 | 281.2 | 39.5 |
| 45 | 44.6 | 6.3 | 05 | 104.0 | 14.6 | 65 | 163.4 | 23.0 | 25 | 222.8 | 31.3 | 85 | 282.2 | 39.7 |
| 46 | 45.6 | 6.4 | 06 | 105.0 | 14.8 | 66 | 164.4 | 23.1 | 26 | 223.8 | 31.5 | 86 | 283.2 | 39.8 |
| 47 | 46.5 | 6.5 | 07 | 106.0 | 14.9 | 67 | 165.4 | 23.2 | 27 | 224.8 | 31.6 | 87 | 284.2 | 39.9 |
| 48 | 47.5 | 6.7 | 08 | 106.9 | 15.0 | 68 | 166.4 | 23.4 | 28 | 225.8 | 31.7 | 88 | 285.2 | 40.1 |
| 49 | 48.5 | 6.8 | 09 | 107.9 | 15.2 | 69 | 167.4 | 23.5 | 29 | 226.8 | 31.9 | 89 | 286.2 | 40.2 |
| 50 | 49.5 | 7.0 | 10 | 108.9 | 15.3 | 70 | 168.3 | 23.7 | 30 | 227.8 | 32.0 | 90 | 287.2 | 40.4 |
| 51 | 50.5 | 7.1 | 111 | 109.9 | 15.4 | 171 | 169.3 | 23.8 | 231 | 228.8 | 32.1 | 291 | 288.2 | 40.5 |
| 52 | 51.5 | 7.2 | 12 | 110.9 | 15.6 | 72 | 170.3 | 23.9 | 32 | 229.7 | 32.3 | 92 | 289.2 | 40.6 |
| 53 | 52.5 | 7.4 | 13 | 111.9 | 15.7 | 73 | 171.3 | 24.1 | 33 | 230.7 | 32.4 | 93 | 290.1 | 40.8 |
| 54 | 53.5 | 7.5 | 14 | 112.9 | 15.9 | 74 | 172.3 | 24.2 | 34 | 231.7 | 32.6 | 94 | 291.1 | 40.9 |
| 55 | 54.5 | 7.7 | 15 | 113.9 | 16.0 | 75 | 173.3 | 24.4 | 35 | 232.7 | 32.7 | 95 | 292.1 | 41.1 |
| 56 | 55.5 | 7.8 | 16 | 114.9 | 16.1 | 76 | 174.3 | 24.5 | 36 | 233.7 | 32.8 | 96 | 293.1 | 41.2 |
| 57 | 56.4 | 7.9 | 17 | 115.9 | 16.3 | 77 | 175.3 | 24.6 | 37 | 234.7 | 33.0 | 97 | 294.1 | 41.3 |
| 58 | 57.4 | 8.1 | 18 | 116.9 | 16.4 | 78 | 176.3 | 24.8 | 38 | 235.7 | 33.1 | 98 | 295.1 | 41.5 |
| 59 | 58.4 | 8.2 | 19 | 117.8 | 16.6 | 79 | 177.3 | 24.9 | 39 | 236.7 | 33.3 | 99 | 296.1 | 41.6 |
| 60 | 59.4 | 8.4 | 20 | 118.8 | 16.7 | 80 | 178.2 | 25.1 | 40 | 237.7 | 33.4 | 300 | 297.1 | 41.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 82 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 9°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.2 | 61 | 60.2 | 9.5 | 121 | 119.5 | 18.9 | 181 | 178.8 | 28.3 | 241 | 238.0 | 37.7 |
| 2 | 2.0 | 0.3 | 62 | 61.2 | 9.7 | 22 | 120.5 | 19.1 | 82 | 179.8 | 28.5 | 42 | 239.0 | 37.9 |
| 3 | 3.0 | 0.5 | 63 | 62.2 | 9.9 | 23 | 121.5 | 19.2 | 83 | 180.7 | 28.6 | 43 | 240.0 | 38.0 |
| 4 | 4.0 | 0.6 | 64 | 63.2 | 10.0 | 24 | 122.5 | 19.4 | 84 | 181.7 | 28.8 | 44 | 241.0 | 38.2 |
| 5 | 4.9 | 0.8 | 65 | 64.2 | 10.2 | 25 | 123.5 | 19.6 | 85 | 182.7 | 28.9 | 45 | 242.0 | 38.3 |
| 6 | 5.9 | 0.9 | 66 | 65.2 | 10.3 | 26 | 124.4 | 19.7 | 86 | 183.7 | 29.1 | 46 | 243.0 | 38.5 |
| 7 | 6.9 | 1.1 | 67 | 66.2 | 10.5 | 27 | 125.4 | 19.9 | 87 | 184.7 | 29.3 | 47 | 244.0 | 38.6 |
| 8 | 7.9 | 1.3 | 68 | 67.2 | 10.6 | 28 | 126.4 | 20.0 | 88 | 185.7 | 29.4 | 48 | 244.9 | 38.8 |
| 9 | 8.9 | 1.4 | 69 | 68.2 | 10.8 | 29 | 127.4 | 20.2 | 89 | 186.7 | 29.6 | 49 | 245.9 | 39.0 |
| 10 | 9.9 | 1.6 | 70 | 69.1 | 11.0 | 30 | 128.4 | 20.3 | 90 | 187.7 | 29.7 | 50 | 246.9 | 39.1 |
| 11 | 10.9 | 1.7 | 71 | 70.1 | 11.1 | 31 | 129.4 | 20.5 | 191 | 188.6 | 29.9 | 251 | 247.9 | 39.3 |
| 12 | 11.9 | 1.9 | 72 | 71.1 | 11.3 | 32 | 130.4 | 20.6 | 92 | 189.6 | 30.0 | 52 | 248.9 | 39.4 |
| 13 | 12.8 | 2.0 | 73 | 72.1 | 11.4 | 33 | 131.4 | 20.8 | 93 | 190.6 | 30.2 | 53 | 249.9 | 39.6 |
| 14 | 13.8 | 2.2 | 74 | 73.1 | 11.6 | 34 | 132.4 | 21.0 | 94 | 191.6 | 30.3 | 54 | 250.9 | 39.7 |
| 15 | 14.8 | 2.3 | 75 | 74.1 | 11.7 | 35 | 133.3 | 21.1 | 95 | 192.6 | 30.5 | 55 | 251.9 | 39.9 |
| 16 | 15.8 | 2.5 | 76 | 75.1 | 11.9 | 36 | 134.3 | 21.3 | 96 | 193.6 | 30.7 | 56 | 252.8 | 40.0 |
| 17 | 16.8 | 2.7 | 77 | 76.1 | 12.0 | 37 | 135.3 | 21.4 | 97 | 194.6 | 30.8 | 57 | 253.8 | 40.2 |
| 18 | 17.8 | 2.8 | 78 | 77.0 | 12.2 | 38 | 136.3 | 21.6 | 98 | 195.6 | 31.0 | 58 | 254.8 | 40.4 |
| 19 | 18.8 | 3.0 | 79 | 78.0 | 12.4 | 39 | 137.3 | 21.7 | 99 | 196.5 | 31.1 | 59 | 255.8 | 40.5 |
| 20 | 19.8 | 3.1 | 80 | 79.0 | 12.5 | 40 | 138.3 | 21.9 | 200 | 197.5 | 31.3 | 60 | 256.8 | 40.7 |
| 21 | 20.7 | 3.3 | 81 | 80.0 | 12.7 | 141 | 139.3 | 22.1 | 201 | 198.5 | 31.4 | 261 | 257.8 | 40.8 |
| 22 | 21.7 | 3.4 | 82 | 81.0 | 12.8 | 42 | 140.3 | 22.2 | 02 | 199.5 | 31.6 | 62 | 258.8 | 41.0 |
| 23 | 22.7 | 3.6 | 83 | 82.0 | 13.0 | 43 | 141.2 | 22.4 | 03 | 200.5 | 31.8 | 63 | 259.8 | 41.1 |
| 24 | 23.7 | 3.8 | 84 | 83.0 | 13.1 | 44 | 142.2 | 22.5 | 04 | 201.5 | 31.9 | 64 | 260.7 | 41.3 |
| 25 | 24.7 | 3.9 | 85 | 84.0 | 13.3 | 45 | 143.2 | 22.7 | 05 | 202.5 | 32.1 | 65 | 261.7 | 41.5 |
| 26 | 25.7 | 4.1 | 86 | 84.9 | 13.5 | 46 | 144.2 | 22.8 | 06 | 203.5 | 32.2 | 66 | 262.7 | 41.6 |
| 27 | 26.7 | 4.2 | 87 | 85.9 | 13.6 | 47 | 145.2 | 23.0 | 07 | 204.5 | 32.4 | 67 | 263.7 | 41.8 |
| 28 | 27.7 | 4.4 | 88 | 86.9 | 13.8 | 48 | 146.2 | 23.2 | 08 | 205.4 | 32.5 | 68 | 264.7 | 41.9 |
| 29 | 28.6 | 4.5 | 89 | 87.9 | 13.9 | 49 | 147.2 | 23.3 | 09 | 206.4 | 32.7 | 69 | 265.7 | 42.1 |
| 30 | 29.6 | 4.7 | 90 | 88.9 | 14.1 | 50 | 148.2 | 23.5 | 10 | 207.4 | 32.9 | 70 | 266.7 | 42.2 |
| 31 | 30.6 | 4.8 | 91 | 89.9 | 14.2 | 151 | 149.1 | 23.6 | 211 | 208.4 | 33.0 | 271 | 267.7 | 42.4 |
| 32 | 31.6 | 5.0 | 92 | 90.9 | 14.4 | 52 | 150.1 | 23.8 | 12 | 209.4 | 33.2 | 72 | 268.7 | 42.6 |
| 33 | 32.6 | 5.2 | 93 | 91.9 | 14.5 | 53 | 151.1 | 23.9 | 13 | 210.4 | 33.3 | 73 | 269.6 | 42.7 |
| 34 | 33.6 | 5.3 | 94 | 92.8 | 14.7 | 54 | 152.1 | 24.1 | 14 | 211.4 | 33.5 | 74 | 270.6 | 42.9 |
| 35 | 34.6 | 5.5 | 95 | 93.8 | 14.9 | 55 | 153.1 | 24.2 | 15 | 212.4 | 33.6 | 75 | 271.6 | 43.0 |
| 36 | 35.6 | 5.6 | 96 | 94.8 | 15.0 | 56 | 154.1 | 24.4 | 16 | 213.3 | 33.8 | 76 | 272.6 | 43.2 |
| 37 | 36.5 | 5.8 | 97 | 95.8 | 15.2 | 57 | 155.1 | 24.6 | 17 | 214.3 | 33.9 | 77 | 273.6 | 43.3 |
| 38 | 37.5 | 5.9 | 98 | 96.8 | 15.3 | 58 | 156.1 | 24.7 | 18 | 215.3 | 34.1 | 78 | 274.6 | 43.5 |
| 39 | 38.5 | 6.1 | 99 | 97.8 | 15.5 | 59 | 157.0 | 24.9 | 19 | 216.3 | 34.3 | 79 | 275.6 | 43.6 |
| 40 | 39.5 | 6.3 | 100 | 98.8 | 15.6 | 60 | 158.0 | 25.0 | 20 | 217.3 | 34.4 | 80 | 276.6 | 43.8 |
| 41 | 40.5 | 6.4 | 101 | 99.8 | 15.8 | 161 | 159.0 | 25.2 | 221 | 218.3 | 34.6 | 281 | 277.5 | 44.0 |
| 42 | 41.5 | 6.6 | 02 | 100.7 | 16.0 | 62 | 160.0 | 25.3 | 22 | 219.3 | 34.7 | 82 | 278.5 | 44.1 |
| 43 | 42.5 | 6.7 | 03 | 101.7 | 16.1 | 63 | 161.0 | 25.5 | 23 | 220.3 | 34.9 | 83 | 279.5 | 44.3 |
| 44 | 43.5 | 6.9 | 04 | 102.7 | 16.3 | 64 | 162.0 | 25.7 | 24 | 221.2 | 35.0 | 84 | 280.5 | 44.4 |
| 45 | 44.4 | 7.0 | 05 | 103.7 | 16.4 | 65 | 163.0 | 25.8 | 25 | 222.2 | 35.2 | 85 | 281.5 | 44.6 |
| 46 | 45.4 | 7.2 | 06 | 104.7 | 16.6 | 66 | 164.0 | 26.0 | 26 | 223.2 | 35.4 | 86 | 282.5 | 44.7 |
| 47 | 46.4 | 7.4 | 07 | 105.7 | 16.7 | 67 | 164.9 | 26.1 | 27 | 224.2 | 35.5 | 87 | 283.5 | 44.9 |
| 48 | 47.4 | 7.5 | 08 | 106.7 | 16.9 | 68 | 165.9 | 26.3 | 28 | 225.2 | 35.7 | 88 | 284.5 | 45.1 |
| 49 | 48.4 | 7.7 | 09 | 107.7 | 17.1 | 69 | 166.9 | 26.4 | 29 | 226.2 | 35.8 | 89 | 285.4 | 45.2 |
| 50 | 49.4 | 7.8 | 10 | 108.6 | 17.2 | 70 | 167.9 | 26.6 | 30 | 227.2 | 36.0 | 90 | 286.4 | 45.4 |
| 51 | 50.4 | 8.0 | 111 | 109.6 | 17.4 | 171 | 168.9 | 26.8 | 231 | 228.2 | 36.1 | 291 | 287.4 | 45.5 |
| 52 | 51.4 | 8.1 | 12 | 110.6 | 17.5 | 72 | 169.9 | 26.9 | 32 | 229.1 | 36.3 | 92 | 288.4 | 45.7 |
| 53 | 52.3 | 8.3 | 13 | 111.6 | 17.7 | 73 | 170.9 | 27.1 | 33 | 230.1 | 36.4 | 93 | 289.4 | 45.8 |
| 54 | 53.3 | 8.4 | 14 | 112.6 | 17.8 | 74 | 171.9 | 27.2 | 34 | 231.1 | 36.6 | 94 | 290.4 | 46.0 |
| 55 | 54.3 | 8.6 | 15 | 113.6 | 18.0 | 75 | 172.8 | 27.4 | 35 | 232.1 | 36.8 | 95 | 291.4 | 46.1 |
| 56 | 55.3 | 8.8 | 16 | 114.6 | 18.1 | 76 | 173.8 | 27.5 | 36 | 233.1 | 36.9 | 96 | 292.4 | 46.3 |
| 57 | 56.3 | 8.9 | 17 | 115.6 | 18.3 | 77 | 174.8 | 27.7 | 37 | 234.1 | 37.1 | 97 | 293.3 | 46.4 |
| 58 | 57.3 | 9.1 | 18 | 116.5 | 18.5 | 78 | 175.8 | 27.8 | 38 | 235.1 | 37.2 | 98 | 294.3 | 46.6 |
| 59 | 58.3 | 9.2 | 19 | 117.5 | 18.6 | 79 | 176.8 | 28.0 | 39 | 236.1 | 37.4 | 99 | 295.3 | 46.8 |
| 60 | 59.3 | 9.4 | 20 | 118.5 | 18.8 | 80 | 177.8 | 28.2 | 40 | 237.0 | 37.5 | 300 | 296.3 | 46.9 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 81 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 10°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.2 | 61 | 60.1 | 10.6 | 121 | 119.2 | 21.0 | 181 | 178.3 | 31.4 | 241 | 237.3 | 41.8 |
| 2 | 2.0 | 0.3 | 62 | 61.1 | 10.8 | 22 | 120.1 | 21.2 | 82 | 179.2 | 31.6 | 42 | 238.3 | 42.0 |
| 3 | 3.0 | 0.5 | 63 | 62.0 | 10.9 | 23 | 121.1 | 21.4 | 83 | 180.2 | 31.8 | 43 | 239.3 | 42.2 |
| 4 | 3.9 | 0.7 | 64 | 63.0 | 11.1 | 24 | 122.1 | 21.5 | 84 | 181.2 | 32.0 | 44 | 240.3 | 42.4 |
| 5 | 4.9 | 0.9 | 65 | 64.0 | 11.3 | 25 | 123.1 | 21.7 | 85 | 182.2 | 32.1 | 45 | 241.3 | 42.5 |
| 6 | 5.9 | 1.0 | 66 | 65.0 | 11.5 | 26 | 124.1 | 21.9 | 86 | 183.2 | 32.3 | 46 | 242.3 | 42.7 |
| 7 | 6.9 | 1.2 | 67 | 66.0 | 11.6 | 27 | 125.1 | 22.1 | 87 | 184.2 | 32.4 | 47 | 243.2 | 42.9 |
| 8 | 7.9 | 1.4 | 68 | 67.0 | 11.8 | 28 | 126.1 | 22.2 | 88 | 185.1 | 32.6 | 48 | 244.2 | 43.1 |
| 9 | 8.9 | 1.6 | 69 | 68.0 | 12.0 | 29 | 127.0 | 22.4 | 89 | 186.1 | 32.8 | 49 | 245.2 | 43.2 |
| 10 | 9.8 | 1.7 | 70 | 68.9 | 12.2 | 30 | 128.0 | 22.6 | 90 | 187.1 | 33.0 | 50 | 246.2 | 43.4 |
| 11 | 10.8 | 1.9 | 71 | 69.9 | 12.3 | 31 | 129.0 | 22.7 | 191 | 188.1 | 33.2 | 251 | 247.2 | 43.6 |
| 12 | 11.8 | 2.1 | 72 | 70.9 | 12.5 | 32 | 130.0 | 22.9 | 92 | 189.1 | 33.3 | 52 | 248.2 | 43.8 |
| 13 | 12.8 | 2.3 | 73 | 71.9 | 12.7 | 33 | 131.0 | 23.1 | 93 | 190.1 | 33.5 | 53 | 249.2 | 43.9 |
| 14 | 13.8 | 2.4 | 74 | 72.9 | 12.8 | 34 | 132.0 | 23.3 | 94 | 191.1 | 33.7 | 54 | 250.1 | 44.1 |
| 15 | 14.8 | 2.6 | 75 | 73.9 | 13.0 | 35 | 132.9 | 23.4 | 95 | 192.0 | 33.9 | 55 | 251.1 | 44.3 |
| 16 | 15.8 | 2.8 | 76 | 74.8 | 13.2 | 36 | 133.9 | 23.6 | 96 | 193.0 | 34.0 | 56 | 252.1 | 44.5 |
| 17 | 16.7 | 3.0 | 77 | 75.8 | 13.4 | 37 | 134.9 | 23.8 | 97 | 194.0 | 34.2 | 57 | 253.1 | 44.6 |
| 18 | 17.7 | 3.1 | 78 | 76.8 | 13.5 | 38 | 135.9 | 24.0 | 98 | 195.0 | 34.4 | 58 | 254.1 | 44.8 |
| 19 | 18.7 | 3.3 | 79 | 77.8 | 13.7 | 39 | 136.9 | 24.1 | 99 | 196.0 | 34.6 | 59 | 255.1 | 45.0 |
| 20 | 19.7 | 3.5 | 80 | 78.8 | 13.9 | 40 | 137.9 | 24.3 | 200 | 197.0 | 34.7 | 60 | 256.1 | 45.1 |
| 21 | 20.7 | 3.6 | 81 | 79.8 | 14.1 | 141 | 138.9 | 24.5 | 201 | 197.9 | 34.9 | 261 | 257.0 | 45.3 |
| 22 | 21.7 | 3.8 | 82 | 80.8 | 14.2 | 42 | 139.8 | 24.7 | 02 | 198.9 | 35.1 | 62 | 258.0 | 45.5 |
| 23 | 22.7 | 4.0 | 83 | 81.7 | 14.4 | 43 | 140.8 | 24.8 | 03 | 199.9 | 35.3 | 63 | 259.0 | 45.7 |
| 24 | 23.6 | 4.2 | 84 | 82.7 | 14.6 | 44 | 141.8 | 25.0 | 04 | 200.9 | 35.4 | 64 | 260.0 | 45.8 |
| 25 | 24.6 | 4.3 | 85 | 83.7 | 14.8 | 45 | 142.8 | 25.2 | 05 | 201.9 | 35.6 | 65 | 261.0 | 46.0 |
| 26 | 25.6 | 4.5 | 86 | 84.7 | 14.9 | 46 | 143.8 | 25.4 | 06 | 202.9 | 35.8 | 66 | 262.0 | 46.2 |
| 27 | 26.6 | 4.7 | 87 | 85.7 | 15.1 | 47 | 144.8 | 25.4 | 07 | 203.9 | 35.9 | 67 | 262.9 | 46.4 |
| 28 | 27.6 | 4.9 | 88 | 86.7 | 15.3 | 48 | 145.8 | 25.7 | 08 | 204.8 | 36.1 | 68 | 263.9 | 46.5 |
| 29 | 28.6 | 5.0 | 89 | 87.6 | 15.5 | 49 | 146.7 | 25.9 | 09 | 205.8 | 36.3 | 69 | 264.9 | 46.7 |
| 30 | 29.5 | 5.2 | 90 | 88.6 | 15.6 | 50 | 147.7 | 26.0 | 10 | 206.8 | 36.5 | 70 | 265.9 | 46.9 |
| 31 | 30.5 | 5.4 | 91 | 89.6 | 15.8 | 151 | 148.7 | 26.2 | 211 | 207.8 | 36.6 | 271 | 266.9 | 47.1 |
| 32 | 31.5 | 5.6 | 92 | 90.6 | 16.0 | 52 | 149.7 | 26.4 | 12 | 208.8 | 36.8 | 72 | 267.9 | 47.2 |
| 33 | 32.5 | 5.7 | 93 | 91.6 | 16.1 | 53 | 150.7 | 26.6 | 13 | 209.8 | 37.0 | 73 | 268.9 | 47.4 |
| 34 | 33.5 | 5.9 | 94 | 92.6 | 16.3 | 54 | 151.7 | 26.7 | 14 | 210.7 | 37.2 | 74 | 269.8 | 47.6 |
| 35 | 34.5 | 6.1 | 95 | 93.6 | 16.5 | 55 | 152.6 | 26.9 | 15 | 211.7 | 37.3 | 75 | 270.8 | 47.8 |
| 36 | 35.5 | 6.3 | 96 | 94.5 | 16.7 | 56 | 153.6 | 27.1 | 16 | 212.7 | 37.5 | 76 | 271.8 | 47.9 |
| 37 | 36.4 | 6.4 | 97 | 95.5 | 16.8 | 57 | 154.6 | 27.3 | 17 | 213.7 | 37.7 | 77 | 272.8 | 48.1 |
| 38 | 37.4 | 6.6 | 98 | 96.5 | 17.0 | 58 | 155.6 | 27.4 | 18 | 214.7 | 37.9 | 78 | 273.8 | 48.3 |
| 39 | 38.4 | 6.8 | 99 | 97.5 | 17.2 | 59 | 156.6 | 27.6 | 19 | 215.7 | 38.0 | 79 | 274.8 | 48.4 |
| 40 | 39.4 | 6.9 | 100 | 98.5 | 17.4 | 60 | 157.6 | 27.8 | 20 | 216.7 | 38.2 | 80 | 275.7 | 48.6 |
| 41 | 40.4 | 7.1 | 101 | 99.5 | 17.5 | 161 | 158.6 | 28.0 | 221 | 217.6 | 38.4 | 281 | 276.7 | 48.8 |
| 42 | 41.4 | 7.3 | 02 | 100.5 | 17.7 | 62 | 159.5 | 28.1 | 22 | 218.6 | 38.5 | 82 | 277.7 | 49.0 |
| 43 | 42.3 | 7.5 | 03 | 101.4 | 17.9 | 63 | 160.5 | 28.3 | 23 | 219.6 | 38.7 | 83 | 278.7 | 49.1 |
| 44 | 43.3 | 7.6 | 04 | 102.4 | 18.1 | 64 | 161.5 | 28.5 | 24 | 220.6 | 38.9 | 84 | 279.7 | 49.3 |
| 45 | 44.3 | 7.8 | 05 | 103.4 | 18.2 | 65 | 162.5 | 28.7 | 25 | 221.6 | 39.1 | 85 | 280.7 | 49.5 |
| 46 | 45.3 | 8.0 | 06 | 104.4 | 18.4 | 66 | 163.5 | 28.8 | 26 | 222.6 | 39.2 | 86 | 281.7 | 49.7 |
| 47 | 46.3 | 8.2 | 07 | 105.4 | 18.6 | 67 | 164.5 | 29.0 | 27 | 223.6 | 39.4 | 87 | 282.6 | 49.8 |
| 48 | 47.3 | 8.3 | 08 | 106.4 | 18.8 | 68 | 165.4 | 29.2 | 28 | 224.5 | 39.6 | 88 | 283.6 | 50.0 |
| 49 | 48.3 | 8.5 | 09 | 107.3 | 18.9 | 69 | 166.4 | 29.3 | 29 | 225.5 | 39.8 | 89 | 284.6 | 50.2 |
| 50 | 49.2 | 8.7 | 10 | 108.3 | 19.1 | 70 | 167.4 | 29.5 | 30 | 226.5 | 39.9 | 90 | 285.6 | 50.4 |
| 51 | 50.2 | 8.9 | 111 | 109.3 | 19.3 | 171 | 168.4 | 29.7 | 231 | 227.5 | 40.1 | 291 | 286.6 | 50.5 |
| 52 | 51.2 | 9.0 | 12 | 110.3 | 19.4 | 72 | 169.4 | 29.9 | 32 | 228.5 | 40.3 | 92 | 287.6 | 50.7 |
| 53 | 52.2 | 9.2 | 13 | 111.3 | 19.6 | 73 | 170.4 | 30.0 | 33 | 229.5 | 40.5 | 93 | 288.5 | 50.9 |
| 54 | 53.2 | 9.4 | 14 | 112.3 | 19.8 | 74 | 171.4 | 30.2 | 34 | 230.4 | 40.6 | 94 | 289.5 | 51.1 |
| 55 | 54.2 | 9.6 | 15 | 113.3 | 20.0 | 75 | 172.3 | 30.4 | 35 | 231.4 | 40.8 | 95 | 290.5 | 51.2 |
| 56 | 55.1 | 9.7 | 16 | 114.2 | 20.1 | 76 | 173.3 | 30.6 | 36 | 232.4 | 41.0 | 96 | 291.5 | 51.4 |
| 57 | 56.1 | 9.9 | 17 | 115.2 | 20.3 | 77 | 174.3 | 30.7 | 37 | 233.4 | 41.2 | 97 | 292.5 | 51.6 |
| 58 | 57.1 | 10.1 | 18 | 116.2 | 20.5 | 78 | 175.3 | 30.9 | 38 | 234.4 | 41.3 | 98 | 293.5 | 51.7 |
| 59 | 58.1 | 10.2 | 19 | 117.2 | 20.7 | 79 | 176.3 | 31.1 | 39 | 235.4 | 41.5 | 99 | 294.5 | 51.9 |
| 60 | 59.1 | 10.4 | 20 | 118.2 | 20.8 | 80 | 177.3 | 31.3 | 40 | 236.4 | 41.7 | 300 | 295.4 | 52.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 80 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 11°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.2 | 61 | 59.9 | 11.6 | 121 | 118.8 | 23.1 | 181 | 177.7 | 34.5 | 241 | 236.6 | 46.0 |
| 2 | 2.0 | 0.4 | 62 | 60.0 | 11.8 | 22 | 119.8 | 23.3 | 82 | 178.7 | 34.7 | 42 | 237.6 | 46.2 |
| 3 | 2.9 | 0.6 | 63 | 61.8 | 12.0 | 23 | 120.7 | 23.5 | 83 | 179.0 | 34.9 | 43 | 238.5 | 46.4 |
| 4 | 3.9 | 0.8 | 64 | 62.8 | 12.2 | 24 | 121.7 | 23.7 | 84 | 180.6 | 35.1 | 44 | 239.5 | 46.6 |
| 5 | 4.9 | 1.0 | 65 | 63.8 | 12.4 | 25 | 122.7 | 23.9 | 85 | 181.6 | 35.3 | 45 | 240.5 | 46.7 |
| 6 | 5.9 | 1.1 | 66 | 64.8 | 12.6 | 26 | 123.7 | 24.0 | 86 | 182.6 | 35.5 | 46 | 241.5 | 46.9 |
| 7 | 6.9 | 1.3 | 67 | 65.8 | 12.8 | 27 | 124.7 | 24.2 | 87 | 183.6 | 35.7 | 47 | 242.5 | 47.1 |
| 8 | 7.9 | 1.5 | 68 | 66.8 | 13.0 | 28 | 125.6 | 24.4 | 88 | 184.5 | 35.9 | 48 | 243.4 | 47.3 |
| 9 | 8.8 | 1.7 | 69 | 67.7 | 13.2 | 29 | 126.6 | 24.6 | 89 | 185.5 | 36.1 | 49 | 244.4 | 47.5 |
| 10 | 9.8 | 1.9 | 70 | 68.7 | 13.4 | 30 | 127.6 | 24.8 | 90 | 186.5 | 36.3 | 50 | 245.4 | 47.7 |
| 11 | 10.8 | 2.1 | 71 | 69.7 | 13.5 | 131 | 128.6 | 25.0 | 191 | 187.5 | 36.4 | 251 | 246.4 | 47.9 |
| 12 | 11.8 | 2.3 | 72 | 70.7 | 13.7 | 32 | 129.6 | 25.2 | 92 | 188.5 | 36.6 | 52 | 247.4 | 48.1 |
| 13 | 12.8 | 2.5 | 73 | 71.7 | 13.9 | 33 | 130.6 | 25.4 | 93 | 189.5 | 36.8 | 53 | 248.4 | 48.3 |
| 14 | 13.7 | 2.7 | 74 | 72.6 | 14.1 | 34 | 131.5 | 25.6 | 94 | 190.4 | 37.0 | 54 | 249.3 | 48.5 |
| 15 | 14.7 | 2.9 | 75 | 73.6 | 14.3 | 35 | 132.5 | 25.8 | 95 | 191.4 | 37.2 | 55 | 250.3 | 48.7 |
| 16 | 15.7 | 3.1 | 76 | 74.6 | 14.5 | 36 | 133.5 | 26.0 | 96 | 192.4 | 37.4 | 56 | 251.3 | 48.8 |
| 17 | 16.7 | 3.2 | 77 | 75.6 | 14.7 | 37 | 134.5 | 26.1 | 97 | 193.4 | 37.6 | 57 | 252.3 | 49.0 |
| 18 | 17.7 | 3.4 | 78 | 76.6 | 14.9 | 38 | 135.5 | 26.3 | 98 | 194.4 | 37.8 | 58 | 253.3 | 49.2 |
| 19 | 18.7 | 3.6 | 79 | 77.5 | 15.1 | 39 | 136.4 | 26.5 | 99 | 195.3 | 38.0 | 59 | 254.2 | 49.4 |
| 20 | 19.6 | 3.8 | 80 | 78.5 | 15.3 | 40 | 137.4 | 26.7 | 200 | 196.3 | 38.2 | 60 | 255.2 | 49.6 |
| 21 | 20.6 | 4.0 | 81 | 79.5 | 15.5 | 141 | 138.4 | 26.9 | 201 | 197.3 | 38.4 | 261 | 256.2 | 49.8 |
| 22 | 21.6 | 4.2 | 82 | 80.5 | 15.6 | 42 | 139.4 | 27.1 | 02 | 198.3 | 38.5 | 62 | 257.2 | 50.0 |
| 23 | 22.6 | 4.4 | 83 | 81.5 | 15.8 | 43 | 140.4 | 27.3 | 03 | 199.3 | 38.7 | 63 | 258.2 | 50.2 |
| 24 | 23.6 | 4.6 | 84 | 82.5 | 16.0 | 44 | 141.4 | 27.5 | 04 | 200.3 | 38.9 | 64 | 259.1 | 50.4 |
| 25 | 24.5 | 4.8 | 85 | 83.4 | 16.2 | 45 | 142.3 | 27.7 | 05 | 201.2 | 39.1 | 65 | 260.1 | 50.6 |
| 26 | 25.5 | 5.0 | 86 | 84.4 | 16.4 | 46 | 143.3 | 27.9 | 06 | 202.2 | 39.3 | 66 | 261.1 | 50.8 |
| 27 | 26.5 | 5.2 | 87 | 85.4 | 16.6 | 47 | 144.3 | 28.0 | 07 | 203.2 | 39.5 | 67 | 262.1 | 50.9 |
| 28 | 27.5 | 5.3 | 88 | 86.4 | 16.8 | 48 | 145.3 | 28.2 | 08 | 204.2 | 39.7 | 68 | 263.1 | 51.1 |
| 29 | 28.5 | 5.5 | 89 | 87.4 | 17.0 | 49 | 146.3 | 28.4 | 09 | 205.2 | 39.9 | 69 | 264.1 | 51.3 |
| 30 | 29.4 | 5.7 | 90 | 88.3 | 17.2 | 50 | 147.2 | 28.6 | 10 | 206.1 | 40.1 | 70 | 265.0 | 51.5 |
| 31 | 30.4 | 5.9 | 91 | 89.3 | 17.4 | 151 | 148.2 | 28.8 | 211 | 207.1 | 40.3 | 271 | 266.0 | 51.7 |
| 32 | 31.4 | 6.1 | 92 | 90.3 | 17.6 | 52 | 149.2 | 29.0 | 12 | 208.1 | 40.5 | 72 | 267.0 | 51.9 |
| 33 | 32.4 | 6.3 | 93 | 91.3 | 17.7 | 53 | 150.2 | 29.2 | 13 | 209.1 | 40.6 | 73 | 268.0 | 52.1 |
| 34 | 33.4 | 6.5 | 94 | 92.3 | 17.9 | 54 | 151.2 | 29.4 | 14 | 210.1 | 40.8 | 74 | 269.0 | 52.3 |
| 35 | 34.4 | 6.7 | 95 | 93.3 | 18.1 | 55 | 152.2 | 29.6 | 15 | 211.0 | 41.0 | 75 | 269.9 | 52.5 |
| 36 | 35.3 | 6.9 | 96 | 94.2 | 18.3 | 56 | 153.1 | 29.8 | 16 | 212.0 | 41.2 | 76 | 270.9 | 52.7 |
| 37 | 36.3 | 7.1 | 97 | 95.2 | 18.5 | 57 | 154.1 | 30.0 | 17 | 213.0 | 41.4 | 77 | 271.9 | 52.9 |
| 38 | 37.3 | 7.3 | 98 | 96.2 | 18.7 | 58 | 155.1 | 30.1 | 18 | 214.0 | 41.6 | 78 | 272.9 | 53.0 |
| 39 | 38.3 | 7.4 | 99 | 97.2 | 18.9 | 59 | 156.1 | 30.3 | 19 | 215.0 | 41.8 | 79 | 273.9 | 53.2 |
| 40 | 39.3 | 7.6 | 100 | 98.2 | 19.1 | 60 | 157.1 | 30.5 | 20 | 216.0 | 42.0 | 80 | 274.9 | 53.4 |
| 41 | 40.2 | 7.8 | 101 | 99.1 | 19.3 | 161 | 158.0 | 30.7 | 221 | 216.9 | 42.2 | 281 | 275.8 | 53.6 |
| 42 | 41.2 | 8.0 | 02 | 100.1 | 19.5 | 62 | 159.0 | 30.9 | 22 | 217.9 | 42.4 | 82 | 276.8 | 53.8 |
| 43 | 42.2 | 8.2 | 03 | 101.1 | 19.7 | 63 | 160.0 | 31.1 | 23 | 218.9 | 42.6 | 83 | 277.8 | 54.0 |
| 44 | 43.2 | 8.4 | 04 | 102.1 | 19.8 | 64 | 161.0 | 31.3 | 24 | 219.9 | 42.7 | 84 | 278.8 | 54.2 |
| 45 | 44.2 | 8.6 | 05 | 103.1 | 20.0 | 65 | 162.0 | 31.5 | 25 | 220.9 | 42.9 | 85 | 279.8 | 54.4 |
| 46 | 45.2 | 8.8 | 06 | 104.1 | 20.2 | 66 | 163.0 | 31.7 | 26 | 221.8 | 43.1 | 86 | 280.7 | 54.6 |
| 47 | 46.1 | 9.0 | 07 | 105.0 | 20.4 | 67 | 163.9 | 31.9 | 27 | 222.8 | 43.3 | 87 | 281.7 | 54.8 |
| 48 | 47.1 | 9.2 | 08 | 106.0 | 20.6 | 68 | 164.9 | 32.1 | 28 | 223.8 | 43.5 | 88 | 282.7 | 55.0 |
| 49 | 48.1 | 9.3 | 09 | 107.0 | 20.8 | 69 | 165.9 | 32.2 | 29 | 224.8 | 43.7 | 89 | 283.7 | 55.1 |
| 50 | 49.1 | 9.5 | 10 | 108.0 | 21.0 | 70 | 166.9 | 32.4 | 30 | 225.8 | 43.9 | 90 | 284.7 | 55.3 |
| 51 | 50.1 | 9.7 | 111 | 109.0 | 21.2 | 171 | 167.9 | 32.6 | 231 | 226.8 | 44.1 | 291 | 285.7 | 55.5 |
| 52 | 51.0 | 9.9 | 12 | 109.9 | 21.4 | 72 | 168.8 | 32.8 | 32 | 227.7 | 44.3 | 92 | 286.6 | 55.7 |
| 53 | 52.0 | 10.1 | 13 | 110.9 | 21.6 | 73 | 169.8 | 33.0 | 33 | 228.7 | 44.5 | 93 | 287.6 | 55.9 |
| 54 | 53.0 | 10.3 | 14 | 111.9 | 21.8 | 74 | 170.8 | 33.2 | 34 | 229.7 | 44.6 | 94 | 288.6 | 56.1 |
| 55 | 54.0 | 10.5 | 15 | 112.9 | 21.9 | 75 | 171.8 | 33.4 | 35 | 230.7 | 44.8 | 95 | 289.6 | 56.3 |
| 56 | 55.0 | 10.7 | 16 | 113.9 | 22.1 | 76 | 172.8 | 33.6 | 36 | 231.7 | 45.0 | 96 | 290.6 | 56.5 |
| 57 | 56.0 | 10.9 | 17 | 114.9 | 22.3 | 77 | 173.7 | 33.8 | 37 | 232.6 | 45.2 | 97 | 291.5 | 56.7 |
| 58 | 56.9 | 11.1 | 18 | 115.8 | 22.5 | 78 | 174.7 | 34.0 | 38 | 233.6 | 45.4 | 98 | 292.5 | 56.9 |
| 59 | 57.9 | 11.3 | 19 | 116.8 | 22.7 | 79 | 175.7 | 34.2 | 39 | 234.6 | 45.6 | 99 | 293.5 | 57.1 |
| 60 | 58.9 | 11.4 | 20 | 117.8 | 22.9 | 80 | 176.7 | 34.3 | 40 | 235.6 | 45.8 | 300 | 294.5 | 57.2 |

[For 79 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 12°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.2 | 61 | 59.7 | 12.7 | 121 | 118.4 | 25.2 | 181 | 177.0 | 37.6 | 241 | 235.7 | 50.1 |
| 2 | 2.0 | 0.4 | 62 | 60.6 | 12.9 | 22 | 119.3 | 25.4 | 82 | 178.0 | 37.8 | 42 | 236.7 | 50.3 |
| 3 | 2.9 | 0.6 | 63 | 61.6 | 13.1 | 23 | 120.3 | 25.6 | 83 | 179.0 | 38.0 | 43 | 237.7 | 50.5 |
| 4 | 3.9 | 0.8 | 64 | 62.6 | 13.3 | 24 | 121.3 | 25.8 | 84 | 180.0 | 38.3 | 44 | 238.7 | 50.7 |
| 5 | 4.9 | 1.0 | 65 | 63.6 | 13.5 | 25 | 122.3 | 26.0 | 85 | 181.0 | 38.5 | 45 | 239.6 | 50.9 |
| 6 | 5.9 | 1.2 | 66 | 64.6 | 13.7 | 26 | 123.2 | 26.2 | 86 | 181.9 | 38.7 | 46 | 240.6 | 51.1 |
| 7 | 6.8 | 1.5 | 67 | 65.5 | 13.9 | 27 | 124.2 | 26.4 | 87 | 182.9 | 38.9 | 47 | 241.6 | 51.4 |
| 8 | 7.8 | 1.7 | 68 | 66.5 | 14.1 | 28 | 125.2 | 26.6 | 88 | 183.9 | 39.1 | 48 | 242.6 | 51.6 |
| 9 | 8.8 | 1.9 | 69 | 67.5 | 14.3 | 29 | 126.2 | 26.8 | 89 | 184.9 | 39.3 | 49 | 243.6 | 51.8 |
| 10 | 9.8 | 2.1 | 70 | 68.5 | 14.6 | 30 | 127.2 | 27.0 | 90 | 185.8 | 39.5 | 50 | 244.5 | 52.0 |
| 11 | 10.8 | 2.3 | 71 | 69.4 | 14.8 | 131 | 128.1 | 27.2 | 191 | 186.8 | 39.7 | 251 | 245.5 | 52.2 |
| 12 | 11.7 | 2.5 | 72 | 70.4 | 15.0 | 32 | 129.1 | 27.4 | 92 | 187.8 | 39.9 | 52 | 246.5 | 52.4 |
| 13 | 12.7 | 2.7 | 73 | 71.4 | 15.2 | 33 | 130.1 | 27.7 | 93 | 188.8 | 40.1 | 53 | 247.5 | 52.6 |
| 14 | 13.7 | 2.9 | 74 | 72.4 | 15.4 | 34 | 131.1 | 27.9 | 94 | 189.8 | 40.3 | 54 | 248.4 | 52.8 |
| 15 | 14.7 | 3.1 | 75 | 73.4 | 15.6 | 35 | 132.0 | 28.1 | 95 | 190.7 | 40.5 | 55 | 249.4 | 53.0 |
| 16 | 15.7 | 3.3 | 76 | 74.3 | 15.8 | 36 | 133.0 | 28.3 | 96 | 191.7 | 40.8 | 56 | 250.4 | 53.2 |
| 17 | 16.6 | 3.5 | 77 | 75.3 | 16.0 | 37 | 134.0 | 28.5 | 97 | 192.7 | 41.0 | 57 | 251.4 | 53.4 |
| 18 | 17.6 | 3.7 | 78 | 76.3 | 16.2 | 38 | 135.0 | 28.7 | 98 | 193.7 | 41.2 | 58 | 252.4 | 53.6 |
| 19 | 18.6 | 4.0 | 79 | 77.3 | 16.4 | 39 | 136.0 | 28.9 | 99 | 194.7 | 41.4 | 59 | 253.3 | 53.8 |
| 20 | 19.6 | 4.2 | 80 | 78.3 | 16.6 | 40 | 136.9 | 29.1 | 200 | 195.6 | 41.6 | 60 | 254.3 | 54.1 |
| 21 | 20.5 | 4.4 | 81 | 79.2 | 16.8 | 141 | 137.9 | 29.3 | 201 | 196.6 | 41.8 | 261 | 255.3 | 54.3 |
| 22 | 21.5 | 4.6 | 82 | 80.2 | 17.0 | 42 | 138.9 | 29.5 | 02 | 197.6 | 42.0 | 62 | 256.3 | 54.5 |
| 23 | 22.5 | 4.8 | 83 | 81.2 | 17.3 | 43 | 139.9 | 29.7 | 03 | 198.6 | 42.2 | 63 | 257.3 | 54.7 |
| 24 | 23.5 | 5.0 | 84 | 82.2 | 17.5 | 44 | 140.9 | 29.9 | 04 | 199.5 | 42.4 | 64 | 258.2 | 54.9 |
| 25 | 24.5 | 5.2 | 85 | 83.1 | 17.7 | 45 | 141.8 | 30.1 | 05 | 200.5 | 42.6 | 65 | 259.2 | 55.1 |
| 26 | 25.4 | 5.4 | 86 | 84.1 | 17.9 | 46 | 142.8 | 30.4 | 06 | 201.5 | 42.8 | 66 | 260.2 | 55.3 |
| 27 | 26.4 | 5.6 | 87 | 85.1 | 18.1 | 47 | 143.8 | 30.6 | 07 | 202.5 | 43.0 | 67 | 261.2 | 55.5 |
| 28 | 27.4 | 5.8 | 88 | 86.1 | 18.3 | 48 | 144.8 | 30.8 | 08 | 203.5 | 43.2 | 68 | 262.1 | 55.7 |
| 29 | 28.4 | 6.0 | 89 | 87.1 | 18.5 | 49 | 145.7 | 31.0 | 09 | 204.4 | 43.5 | 69 | 263.1 | 55.9 |
| 30 | 29.3 | 6.2 | 90 | 88.0 | 18.7 | 50 | 146.7 | 31.2 | 10 | 205.4 | 43.7 | 70 | 264.1 | 56.1 |
| 31 | 30.3 | 6.4 | 91 | 89.0 | 18.9 | 151 | 147.7 | 31.4 | 211 | 206.4 | 43.9 | 271 | 265.1 | 56.3 |
| 32 | 31.3 | 6.7 | 92 | 90.0 | 19.1 | 52 | 148.7 | 31.6 | 12 | 207.4 | 44.1 | 72 | 266.1 | 56.6 |
| 33 | 32.3 | 6.9 | 93 | 91.0 | 19.3 | 53 | 149.7 | 31.8 | 13 | 208.3 | 44.3 | 73 | 267.0 | 56.8 |
| 34 | 33.3 | 7.1 | 94 | 91.9 | 19.5 | 54 | 150.6 | 32.0 | 14 | 209.3 | 44.5 | 74 | 268.0 | 57.0 |
| 35 | 34.2 | 7.3 | 95 | 92.9 | 19.8 | 55 | 151.6 | 32.2 | 15 | 210.3 | 44.7 | 75 | 269.0 | 57.2 |
| 36 | 35.2 | 7.5 | 96 | 93.9 | 20.0 | 56 | 152.6 | 32.4 | 16 | 211.3 | 44.9 | 76 | 270.0 | 57.4 |
| 37 | 36.2 | 7.7 | 97 | 94.9 | 20.2 | 57 | 153.6 | 32.6 | 17 | 212.3 | 45.1 | 77 | 270.9 | 57.6 |
| 38 | 37.2 | 7.9 | 98 | 95.9 | 20.4 | 58 | 154.5 | 32.9 | 18 | 213.2 | 45.3 | 78 | 271.9 | 57.8 |
| 39 | 38.1 | 8.1 | 99 | 96.8 | 20.6 | 59 | 155.5 | 33.1 | 19 | 214.2 | 45.5 | 79 | 272.9 | 58.0 |
| 40 | 39.1 | 8.3 | 100 | 97.8 | 20.8 | 60 | 156.5 | 33.3 | 20 | 215.2 | 45.7 | 80 | 273.9 | 58.2 |
| 41 | 40.1 | 8.5 | 101 | 98.8 | 21.0 | 161 | 157.5 | 33.5 | 221 | 216.2 | 45.9 | 281 | 274.9 | 58.4 |
| 42 | 41.1 | 8.7 | 02 | 99.8 | 21.2 | 62 | 158.5 | 33.7 | 22 | 217.1 | 46.2 | 82 | 275.8 | 58.6 |
| 43 | 42.1 | 8.9 | 03 | 100.7 | 21.4 | 63 | 159.4 | 33.9 | 23 | 218.1 | 46.4 | 83 | 276.8 | 58.8 |
| 44 | 43.0 | 9.1 | 04 | 101.7 | 21.6 | 64 | 160.4 | 34.1 | 24 | 219.1 | 46.6 | 84 | 277.8 | 59.0 |
| 45 | 44.0 | 9.4 | 05 | 102.7 | 21.8 | 65 | 161.4 | 34.3 | 25 | 220.1 | 46.8 | 85 | 278.8 | 59.3 |
| 46 | 45.0 | 9.6 | 06 | 103.7 | 22.0 | 66 | 162.4 | 34.5 | 26 | 221.1 | 47.0 | 86 | 279.8 | 59.5 |
| 47 | 46.0 | 9.8 | 07 | 104.7 | 22.2 | 67 | 163.4 | 34.7 | 27 | 222.0 | 47.2 | 87 | 280.7 | 59.7 |
| 48 | 47.0 | 10.0 | 08 | 105.7 | 22.5 | 68 | 164.3 | 34.9 | 28 | 223.0 | 47.4 | 88 | 281.7 | 59.9 |
| 49 | 47.9 | 10.2 | 09 | 106.6 | 22.7 | 69 | 165.3 | 35.1 | 29 | 224.0 | 47.6 | 89 | 282.7 | 60.1 |
| 50 | 48.9 | 10.4 | 10 | 107.6 | 22.9 | 70 | 166.3 | 35.3 | 30 | 225.0 | 47.8 | 90 | 283.7 | 60.3 |
| 51 | 49.9 | 10.6 | 111 | 108.6 | 23.1 | 171 | 167.3 | 35.6 | 231 | 226.0 | 48.0 | 291 | 284.6 | 60.5 |
| 52 | 50.9 | 10.8 | 12 | 109.6 | 23.3 | 72 | 168.2 | 35.8 | 32 | 226.9 | 48.2 | 92 | 285.6 | 60.7 |
| 53 | 51.8 | 11.0 | 13 | 110.5 | 23.5 | 73 | 169.2 | 36.0 | 33 | 227.9 | 48.4 | 93 | 286.6 | 60.9 |
| 54 | 52.8 | 11.2 | 14 | 111.5 | 23.7 | 74 | 170.2 | 36.2 | 34 | 228.9 | 48.7 | 94 | 287.6 | 61.1 |
| 55 | 53.8 | 11.4 | 15 | 112.5 | 23.9 | 75 | 171.2 | 36.4 | 35 | 229.9 | 48.9 | 95 | 288.6 | 61.3 |
| 56 | 54.8 | 11.6 | 16 | 113.5 | 24.1 | 76 | 172.2 | 36.6 | 36 | 230.8 | 49.1 | 96 | 289.5 | 61.5 |
| 57 | 55.8 | 11.9 | 17 | 114.4 | 24.3 | 77 | 173.1 | 36.8 | 37 | 231.8 | 49.3 | 97 | 290.5 | 61.7 |
| 58 | 56.7 | 12.1 | 18 | 115.4 | 24.5 | 78 | 174.1 | 37.0 | 38 | 232.8 | 49.5 | 98 | 291.5 | 62.0 |
| 59 | 57.7 | 12.3 | 19 | 116.4 | 24.7 | 79 | 175.1 | 37.2 | 39 | 233.8 | 49.7 | 99 | 292.5 | 62.2 |
| 60 | 58.7 | 12.5 | 20 | 117.4 | 24.9 | 80 | 176.1 | 37.4 | 40 | 234.8 | 49.9 | 300 | 293.4 | 62.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 78 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 13°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.2 | 61 | 59.4 | 13.7 | 121 | 117.9 | 27.2 | 181 | 176.4 | 40.7 | 241 | 234.8 | 54.2 |
| 2 | 1.9 | 0.4 | 62 | 60.4 | 13.9 | 22 | 118.9 | 27.4 | 82 | 177.3 | 40.9 | 42 | 235.8 | 54.4 |
| 3 | 2.9 | 0.7 | 63 | 61.4 | 14.2 | 23 | 119.8 | 27.7 | 83 | 178.3 | 41.2 | 43 | 236.8 | 54.7 |
| 4 | 3.9 | 0.9 | 64 | 62.4 | 14.4 | 24 | 120.8 | 27.9 | 84 | 179.3 | 41.4 | 44 | 237.7 | 54.9 |
| 5 | 4.9 | 1.1 | 65 | 63.3 | 14.6 | 25 | 121.8 | 28.1 | 85 | 180.3 | 41.6 | 45 | 238.7 | 55.1 |
| 6 | 5.8 | 1.3 | 66 | 64.3 | 14.8 | 26 | 122.8 | 28.3 | 86 | 181.2 | 41.8 | 46 | 239.7 | 55.3 |
| 7 | 6.8 | 1.6 | 67 | 65.3 | 15.1 | 27 | 123.7 | 28.6 | 87 | 182.2 | 42.1 | 47 | 240.7 | 55.6 |
| 8 | 7.8 | 1.8 | 68 | 66.3 | 15.3 | 28 | 124.7 | 28.8 | 88 | 183.2 | 42.3 | 48 | 241.6 | 55.8 |
| 9 | 8.8 | 2.0 | 69 | 67.2 | 15.5 | 29 | 125.7 | 29.0 | 89 | 184.2 | 42.5 | 49 | 242.6 | 56.0 |
| 10 | 9.7 | 2.2 | 70 | 68.2 | 15.7 | 30 | 126.7 | 29.2 | 90 | 185.1 | 42.7 | 50 | 243.6 | 56.2 |
| 11 | 10.7 | 2.5 | 71 | 69.2 | 16.0 | 31 | 127.6 | 29.5 | 91 | 186.1 | 43.0 | 51 | 244.6 | 56.5 |
| 12 | 11.7 | 2.7 | 72 | 70.2 | 16.2 | 32 | 128.6 | 29.7 | 92 | 187.1 | 43.2 | 52 | 245.5 | 56.7 |
| 13 | 12.7 | 2.9 | 73 | 71.1 | 16.4 | 33 | 129.6 | 29.9 | 93 | 188.1 | 43.4 | 53 | 246.5 | 56.9 |
| 14 | 13.6 | 3.1 | 74 | 72.1 | 16.6 | 34 | 130.6 | 30.1 | 94 | 189.0 | 43.6 | 54 | 247.5 | 57.1 |
| 15 | 14.6 | 3.4 | 75 | 73.1 | 16.9 | 35 | 131.5 | 30.4 | 95 | 190.0 | 43.9 | 55 | 248.5 | 57.4 |
| 16 | 15.6 | 3.6 | 76 | 74.1 | 17.1 | 36 | 132.5 | 30.6 | 96 | 191.0 | 44.1 | 56 | 249.4 | 57.6 |
| 17 | 16.6 | 3.8 | 77 | 75.0 | 17.3 | 37 | 133.5 | 30.8 | 97 | 192.0 | 44.3 | 57 | 250.4 | 57.8 |
| 18 | 17.5 | 4.0 | 78 | 76.0 | 17.5 | 38 | 134.5 | 31.0 | 98 | 192.9 | 44.5 | 58 | 251.4 | 58.0 |
| 19 | 18.5 | 4.3 | 79 | 77.0 | 17.8 | 39 | 135.4 | 31.3 | 99 | 193.9 | 44.8 | 59 | 252.4 | 58.3 |
| 20 | 19.5 | 4.5 | 80 | 77.9 | 18.0 | 40 | 136.4 | 31.5 | 200 | 194.9 | 45.0 | 60 | 253.3 | 58.5 |
| 21 | 20.5 | 4.7 | 81 | 78.9 | 18.2 | 141 | 137.4 | 31.7 | 201 | 195.8 | 45.2 | 261 | 254.3 | 58.7 |
| 22 | 21.4 | 4.9 | 82 | 79.9 | 18.4 | 42 | 138.4 | 31.9 | 02 | 196.8 | 45.4 | 62 | 255.3 | 58.9 |
| 23 | 22.4 | 5.2 | 83 | 80.9 | 18.7 | 43 | 139.3 | 32.2 | 03 | 197.8 | 45.7 | 63 | 256.3 | 59.2 |
| 24 | 23.4 | 5.4 | 84 | 81.8 | 18.9 | 44 | 140.3 | 32.4 | 04 | 198.8 | 45.9 | 64 | 257.2 | 59.4 |
| 25 | 24.4 | 5.6 | 85 | 82.8 | 19.1 | 45 | 141.3 | 32.6 | 05 | 199.7 | 46.1 | 65 | 258.2 | 59.6 |
| 26 | 25.3 | 5.8 | 86 | 83.8 | 19.3 | 46 | 142.3 | 32.8 | 06 | 200.7 | 46.3 | 66 | 259.2 | 59.8 |
| 27 | 26.3 | 6.1 | 87 | 84.8 | 19.6 | 47 | 143.2 | 33.1 | 07 | 201.7 | 46.6 | 67 | 260.2 | 60.1 |
| 28 | 27.3 | 6.3 | 88 | 85.7 | 19.8 | 48 | 144.2 | 33.3 | 08 | 202.7 | 46.8 | 68 | 261.1 | 60.3 |
| 29 | 28.3 | 6.5 | 89 | 86.7 | 20.0 | 49 | 145.2 | 33.5 | 09 | 203.6 | 47.0 | 69 | 262.1 | 60.5 |
| 30 | 29.2 | 6.7 | 90 | 87.7 | 20.2 | 50 | 146.2 | 33.7 | 10 | 204.6 | 47.2 | 70 | 263.1 | 60.7 |
| 31 | 30.2 | 7.0 | 91 | 88.7 | 20.5 | 151 | 147.1 | 34.0 | 211 | 205.6 | 47.5 | 271 | 264.1 | 61.0 |
| 32 | 31.2 | 7.2 | 92 | 89.6 | 20.7 | 52 | 148.1 | 34.2 | 12 | 206.6 | 47.7 | 72 | 265.0 | 61.2 |
| 33 | 32.2 | 7.4 | 93 | 90.6 | 20.9 | 53 | 149.1 | 34.4 | 13 | 207.5 | 47.9 | 73 | 266.0 | 61.4 |
| 34 | 33.1 | 7.6 | 94 | 91.6 | 21.1 | 54 | 150.1 | 34.6 | 14 | 208.5 | 48.1 | 74 | 267.0 | 61.6 |
| 35 | 34.1 | 7.9 | 95 | 92.6 | 21.4 | 55 | 151.0 | 34.9 | 15 | 209.5 | 48.4 | 75 | 268.0 | 61.9 |
| 36 | 35.1 | 8.1 | 96 | 93.5 | 21.6 | 56 | 152.0 | 35.1 | 16 | 210.5 | 48.6 | 76 | 269.0 | 62.1 |
| 37 | 36.1 | 8.3 | 97 | 94.5 | 21.8 | 57 | 153.0 | 35.3 | 17 | 211.4 | 48.8 | 77 | 269.9 | 62.3 |
| 38 | 37.0 | 8.5 | 98 | 95.5 | 22.0 | 58 | 154.0 | 35.5 | 18 | 212.4 | 49.0 | 78 | 270.9 | 62.5 |
| 39 | 38.0 | 8.8 | 99 | 96.5 | 22.3 | 59 | 154.9 | 35.8 | 19 | 213.4 | 49.3 | 79 | 271.8 | 62.8 |
| 40 | 39.0 | 9.0 | 100 | 97.4 | 22.5 | 60 | 155.9 | 36.0 | 20 | 214.4 | 49.5 | 80 | 272.8 | 63.0 |
| 41 | 39.9 | 9.2 | 101 | 98.4 | 22.7 | 161 | 156.9 | 36.2 | 221 | 215.3 | 49.7 | 281 | 273.8 | 63.2 |
| 42 | 40.9 | 9.4 | 02 | 99.4 | 22.9 | 62 | 157.8 | 36.4 | 22 | 216.3 | 49.9 | 82 | 274.8 | 63.4 |
| 43 | 41.9 | 9.7 | 03 | 100.4 | 23.2 | 63 | 158.8 | 36.7 | 23 | 217.3 | 50.2 | 83 | 275.7 | 63.7 |
| 44 | 42.9 | 9.9 | 04 | 101.3 | 23.4 | 64 | 159.8 | 36.9 | 24 | 218.3 | 50.4 | 84 | 276.7 | 63.9 |
| 45 | 43.8 | 10.1 | 05 | 102.3 | 23.6 | 65 | 160.8 | 37.1 | 25 | 219.2 | 50.6 | 85 | 277.7 | 64.1 |
| 46 | 44.8 | 10.3 | 06 | 103.3 | 23.8 | 66 | 161.7 | 37.3 | 26 | 220.2 | 50.8 | 86 | 278.7 | 64.3 |
| 47 | 45.8 | 10.6 | 07 | 104.3 | 24.1 | 67 | 162.7 | 37.6 | 27 | 221.2 | 51.1 | 87 | 279.6 | 64.6 |
| 48 | 46.8 | 10.8 | 08 | 105.2 | 24.3 | 68 | 163.7 | 37.8 | 28 | 222.2 | 51.3 | 88 | 280.6 | 64.8 |
| 49 | 47.7 | 11.0 | 09 | 106.2 | 24.5 | 69 | 164.7 | 38.0 | 29 | 223.1 | 51.5 | 89 | 281.6 | 65.0 |
| 50 | 48.7 | 11.2 | 10 | 107.2 | 24.7 | 70 | 165.6 | 38.2 | 30 | 224.1 | 51.7 | 90 | 282.6 | 65.2 |
| 51 | 49.7 | 11.5 | 111 | 108.2 | 25.0 | 171 | 166.6 | 38.5 | 231 | 225.1 | 52.0 | 291 | 283.5 | 65.5 |
| 52 | 50.7 | 11.7 | 12 | 109.1 | 25.2 | 72 | 167.6 | 38.7 | 32 | 226.1 | 52.2 | 92 | 284.5 | 65.7 |
| 53 | 51.6 | 11.9 | 13 | 110.1 | 25.4 | 73 | 168.6 | 38.9 | 33 | 227.0 | 52.4 | 93 | 285.5 | 65.9 |
| 54 | 52.6 | 12.1 | 14 | 111.1 | 25.6 | 74 | 169.5 | 39.1 | 34 | 228.0 | 52.6 | 94 | 286.5 | 66.1 |
| 55 | 53.6 | 12.4 | 15 | 112.1 | 25.9 | 75 | 170.5 | 39.4 | 35 | 229.0 | 52.9 | 95 | 287.4 | 66.4 |
| 56 | 54.6 | 12.6 | 16 | 113.0 | 26.1 | 76 | 171.5 | 39.6 | 36 | 230.0 | 53.1 | 96 | 288.4 | 66.6 |
| 57 | 55.5 | 12.8 | 17 | 114.0 | 26.3 | 77 | 172.5 | 39.8 | 37 | 230.9 | 53.3 | 97 | 289.4 | 66.8 |
| 58 | 56.5 | 13.0 | 18 | 115.0 | 26.5 | 78 | 173.4 | 40.0 | 38 | 231.9 | 53.5 | 98 | 290.4 | 67.0 |
| 59 | 57.5 | 13.3 | 19 | 116.0 | 26.8 | 79 | 174.4 | 40.3 | 39 | 232.9 | 53.8 | 99 | 291.3 | 67.3 |
| 60 | 58.5 | 13.5 | 20 | 116.9 | 27.0 | 80 | 175.4 | 40.5 | 40 | 233.8 | 54.0 | 300 | 292.3 | 67.5 |

[For 77 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 14°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.2 | 61 | 59.2 | 14.8 | 121 | 117.4 | 29.3 | 181 | 175.6 | 43.8 | 241 | 233.8 | 58.3 |
| 2 | 1.9 | 0.5 | 62 | 60.2 | 15.0 | 22 | 118.4 | 29.5 | 82 | 176.6 | 44.0 | 42 | 234.8 | 58.5 |
| 3 | 2.9 | 0.7 | 63 | 61.1 | 15.2 | 23 | 119.3 | 29.8 | 83 | 177.6 | 44.3 | 43 | 235.8 | 58.8 |
| 4 | 3.9 | 1.0 | 64 | 62.1 | 15.5 | 24 | 120.3 | 30.0 | 84 | 178.5 | 44.5 | 44 | 236.8 | 59.0 |
| 5 | 4.9 | 1.2 | 65 | 63.1 | 15.7 | 25 | 121.3 | 30.2 | 85 | 179.5 | 44.8 | 45 | 237.7 | 59.3 |
| 6 | 5.8 | 1.5 | 66 | 64.0 | 16.0 | 26 | 122.3 | 30.5 | 86 | 180.5 | 45.0 | 46 | 238.7 | 59.5 |
| 7 | 6.8 | 1.7 | 67 | 65.0 | 16.2 | 27 | 123.2 | 30.7 | 87 | 181.4 | 45.2 | 47 | 239.7 | 59.8 |
| 8 | 7.8 | 1.9 | 68 | 66.0 | 16.5 | 28 | 124.2 | 31.0 | 88 | 182.4 | 45.5 | 48 | 240.6 | 60.0 |
| 9 | 8.7 | 2.2 | 69 | 67.0 | 16.7 | 29 | 125.2 | 31.2 | 89 | 183.4 | 45.7 | 49 | 241.6 | 60.2 |
| 10 | 9.7 | 2.4 | 70 | 67.9 | 16.9 | 30 | 126.1 | 31.4 | 90 | 184.4 | 46.0 | 50 | 242.6 | 60.5 |
| 11 | 10.7 | 2.7 | 71 | 68.9 | 17.2 | 31 | 127.1 | 31.7 | 91 | 185.3 | 46.2 | 51 | 243.5 | 60.7 |
| 12 | 11.6 | 2.9 | 72 | 69.9 | 17.4 | 32 | 128.1 | 31.9 | 92 | 186.3 | 46.4 | 52 | 244.5 | 61.0 |
| 13 | 12.6 | 3.1 | 73 | 70.8 | 17.7 | 33 | 129.0 | 32.2 | 93 | 187.3 | 46.7 | 53 | 245.5 | 61.2 |
| 14 | 13.6 | 3.4 | 74 | 71.8 | 17.9 | 34 | 130.0 | 32.4 | 94 | 188.2 | 46.9 | 54 | 246.5 | 61.4 |
| 15 | 14.6 | 3.6 | 75 | 72.8 | 18.1 | 35 | 131.0 | 32.7 | 95 | 189.2 | 47.2 | 55 | 247.4 | 61.7 |
| 16 | 15.5 | 3.9 | 76 | 73.7 | 18.4 | 36 | 132.0 | 32.9 | 96 | 190.2 | 47.4 | 56 | 248.4 | 61.9 |
| 17 | 16.5 | 4.1 | 77 | 74.7 | 18.6 | 37 | 132.9 | 33.1 | 97 | 191.1 | 47.7 | 57 | 249.4 | 62.2 |
| 18 | 17.5 | 4.4 | 78 | 75.7 | 18.9 | 38 | 133.9 | 33.4 | 98 | 192.1 | 47.9 | 58 | 250.3 | 62.4 |
| 19 | 18.4 | 4.6 | 79 | 76.7 | 19.1 | 39 | 134.9 | 33.6 | 99 | 193.1 | 48.1 | 59 | 251.3 | 62.7 |
| 20 | 19.4 | 4.8 | 80 | 77.6 | 19.4 | 40 | 135.8 | 33.9 | 200 | 194.1 | 48.4 | 60 | 252.3 | 62.9 |
| 21 | 20.4 | 5.1 | 81 | 78.6 | 19.6 | 41 | 136.8 | 34.1 | 201 | 195.0 | 48.6 | 61 | 253.2 | 63.1 |
| 22 | 21.3 | 5.3 | 82 | 79.6 | 19.8 | 42 | 137.8 | 34.4 | 02 | 196.0 | 48.9 | 62 | 254.2 | 63.4 |
| 23 | 22.3 | 5.6 | 83 | 80.5 | 20.1 | 43 | 138.8 | 34.6 | 03 | 197.0 | 49.1 | 63 | 255.2 | 63.6 |
| 24 | 23.3 | 5.8 | 84 | 81.5 | 20.3 | 44 | 139.7 | 34.8 | 04 | 197.9 | 49.4 | 64 | 256.2 | 63.9 |
| 25 | 24.3 | 6.0 | 85 | 82.5 | 20.6 | 45 | 140.7 | 35.1 | 05 | 198.9 | 49.6 | 65 | 257.1 | 64.1 |
| 26 | 25.2 | 6.3 | 86 | 83.4 | 20.8 | 46 | 141.7 | 35.3 | 06 | 199.9 | 49.8 | 66 | 258.1 | 64.4 |
| 27 | 26.2 | 6.5 | 87 | 84.4 | 21.0 | 47 | 142.6 | 35.6 | 07 | 200.9 | 50.1 | 67 | 259.1 | 64.6 |
| 28 | 27.2 | 6.8 | 88 | 85.4 | 21.3 | 48 | 143.6 | 35.8 | 08 | 201.8 | 50.3 | 68 | 260.0 | 64.8 |
| 29 | 28.1 | 7.0 | 89 | 86.4 | 21.5 | 49 | 144.6 | 36.0 | 09 | 202.8 | 50.6 | 69 | 261.0 | 65.1 |
| 30 | 29.1 | 7.3 | 90 | 87.3 | 21.8 | 50 | 145.5 | 36.3 | 10 | 203.8 | 50.8 | 70 | 262.0 | 65.3 |
| 31 | 30.1 | 7.5 | 91 | 88.3 | 22.0 | 51 | 146.5 | 36.5 | 211 | 204.7 | 51.0 | 271 | 263.0 | 65.6 |
| 32 | 31.0 | 7.7 | 92 | 89.3 | 22.3 | 52 | 147.5 | 36.8 | 12 | 205.7 | 51.3 | 72 | 263.9 | 65.8 |
| 33 | 32.0 | 8.0 | 93 | 90.2 | 22.5 | 53 | 148.5 | 37.0 | 13 | 206.7 | 51.5 | 73 | 264.9 | 66.0 |
| 34 | 33.0 | 8.2 | 94 | 91.2 | 22.7 | 54 | 149.4 | 37.3 | 14 | 207.6 | 51.8 | 74 | 265.9 | 66.3 |
| 35 | 34.0 | 8.5 | 95 | 92.2 | 23.0 | 55 | 150.4 | 37.5 | 15 | 208.6 | 52.0 | 75 | 266.8 | 66.5 |
| 36 | 34.9 | 8.7 | 96 | 93.1 | 23.2 | 56 | 151.4 | 37.7 | 16 | 209.6 | 52.3 | 76 | 267.8 | 66.8 |
| 37 | 35.9 | 9.0 | 97 | 94.1 | 23.5 | 57 | 152.3 | 38.0 | 17 | 210.6 | 52.5 | 77 | 268.8 | 67.0 |
| 38 | 36.9 | 9.2 | 98 | 95.1 | 23.7 | 58 | 153.3 | 38.2 | 18 | 211.5 | 52.7 | 78 | 269.7 | 67.3 |
| 39 | 37.8 | 9.4 | 99 | 96.1 | 24.0 | 59 | 154.3 | 38.5 | 19 | 212.5 | 53.0 | 79 | 270.7 | 67.5 |
| 40 | 38.8 | 9.7 | 100 | 97.0 | 24.2 | 60 | 155.2 | 38.7 | 20 | 213.5 | 53.2 | 80 | 271.7 | 67.7 |
| 41 | 39.8 | 9.9 | 101 | 98.0 | 24.4 | 161 | 156.2 | 38.9 | 221 | 214.4 | 53.5 | 281 | 272.7 | 68.0 |
| 42 | 40.8 | 10.2 | 02 | 99.0 | 24.7 | 62 | 157.2 | 39.2 | 22 | 215.4 | 53.7 | 82 | 273.6 | 68.2 |
| 43 | 41.7 | 10.4 | 03 | 99.9 | 24.9 | 63 | 158.2 | 39.4 | 23 | 216.4 | 53.9 | 83 | 274.6 | 68.5 |
| 44 | 42.7 | 10.6 | 04 | 100.9 | 25.2 | 64 | 159.1 | 39.7 | 24 | 217.3 | 54.2 | 84 | 275.6 | 68.7 |
| 45 | 43.7 | 10.9 | 05 | 101.9 | 25.4 | 65 | 160.1 | 39.9 | 25 | 218.3 | 54.4 | 85 | 276.5 | 68.9 |
| 46 | 44.6 | 11.1 | 06 | 102.9 | 25.6 | 66 | 161.1 | 40.2 | 26 | 219.3 | 54.7 | 86 | 277.5 | 69.2 |
| 47 | 45.6 | 11.4 | 07 | 103.8 | 25.9 | 67 | 162.0 | 40.4 | 27 | 220.3 | 54.9 | 87 | 278.5 | 69.4 |
| 48 | 46.6 | 11.6 | 08 | 104.8 | 26.1 | 68 | 163.0 | 40.6 | 28 | 221.2 | 55.2 | 88 | 279.4 | 69.7 |
| 49 | 47.5 | 11.9 | 09 | 105.8 | 26.4 | 69 | 164.0 | 40.9 | 29 | 222.2 | 55.4 | 89 | 280.4 | 69.9 |
| 50 | 48.5 | 12.1 | 10 | 106.7 | 26.6 | 70 | 165.0 | 41.1 | 30 | 223.2 | 55.6 | 90 | 281.4 | 70.2 |
| 51 | 49.5 | 12.3 | 111 | 107.7 | 26.9 | 171 | 165.9 | 41.4 | 231 | 224.1 | 55.9 | 291 | 282.4 | 70.4 |
| 52 | 50.5 | 12.6 | 12 | 108.7 | 27.1 | 72 | 166.9 | 41.6 | 32 | 225.1 | 56.1 | 92 | 283.3 | 70.6 |
| 53 | 51.4 | 12.8 | 13 | 109.6 | 27.3 | 73 | 167.9 | 41.9 | 33 | 226.1 | 56.4 | 93 | 284.3 | 70.9 |
| 54 | 52.4 | 13.1 | 14 | 110.6 | 27.6 | 74 | 168.8 | 42.1 | 34 | 227.0 | 56.6 | 94 | 285.3 | 71.1 |
| 55 | 53.4 | 13.3 | 15 | 111.6 | 27.8 | 75 | 169.8 | 42.3 | 35 | 228.0 | 56.9 | 95 | 286.2 | 71.4 |
| 56 | 54.3 | 13.5 | 16 | 112.6 | 28.1 | 76 | 170.8 | 42.6 | 36 | 229.0 | 57.1 | 96 | 287.2 | 71.6 |
| 57 | 55.3 | 13.8 | 17 | 113.5 | 28.3 | 77 | 171.7 | 42.8 | 37 | 230.0 | 57.3 | 97 | 288.2 | 71.9 |
| 58 | 56.3 | 14.0 | 18 | 114.5 | 28.5 | 78 | 172.7 | 43.1 | 38 | 230.9 | 57.6 | 98 | 289.1 | 72.1 |
| 59 | 57.2 | 14.3 | 19 | 115.5 | 28.8 | 79 | 173.7 | 43.3 | 39 | 231.9 | 57.8 | 99 | 290.1 | 72.3 |
| 60 | 58.2 | 14.5 | 20 | 116.4 | 29.0 | 80 | 174.7 | 43.5 | 40 | 232.9 | 58.1 | 300 | 291.1 | 72.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 76 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 15°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.3 | 61 | 58.9 | 15.8 | 121 | 116.9 | 31.3 | 181 | 174.8 | 46.8 | 241 | 232.8 | 62.4 |
| 2 | 1.9 | 0.5 | 62 | 59.9 | 16.0 | 22 | 117.8 | 31.6 | 82 | 175.8 | 47.1 | 42 | 233.8 | 62.6 |
| 3 | 2.9 | 0.8 | 63 | 60.9 | 16.3 | 23 | 118.8 | 31.8 | 83 | 176.8 | 47.4 | 43 | 234.7 | 62.9 |
| 4 | 3.9 | 1.0 | 64 | 61.8 | 16.6 | 24 | 119.8 | 32.1 | 84 | 177.7 | 47.6 | 44 | 235.7 | 63.2 |
| 5 | 4.8 | 1.3 | 65 | 62.8 | 16.8 | 25 | 120.7 | 32.4 | 85 | 178.7 | 47.9 | 45 | 236.7 | 63.4 |
| 6 | 5.8 | 1.6 | 66 | 63.8 | 17.1 | 26 | 121.7 | 32.6 | 86 | 179.7 | 48.1 | 46 | 237.6 | 63.7 |
| 7 | 6.8 | 1.8 | 67 | 64.7 | 17.3 | 27 | 122.7 | 32.9 | 87 | 180.6 | 48.4 | 47 | 238.6 | 63.9 |
| 8 | 7.7 | 2.1 | 68 | 65.7 | 17.6 | 28 | 123.6 | 33.1 | 88 | 181.6 | 48.7 | 48 | 239.5 | 64.2 |
| 9 | 8.7 | 2.3 | 69 | 66.6 | 17.9 | 29 | 124.6 | 33.4 | 89 | 182.6 | 48.9 | 49 | 240.5 | 64.4 |
| 10 | 9.7 | 2.6 | 70 | 67.6 | 18.1 | 30 | 125.6 | 33.6 | 90 | 183.5 | 49.2 | 50 | 241.5 | 64.7 |
| 11 | 10.6 | 2.8 | 71 | 68.6 | 18.4 | 31 | 126.5 | 33.9 | 191 | 184.5 | 49.4 | 51 | 242.4 | 65.0 |
| 12 | 11.6 | 3.1 | 72 | 69.5 | 18.6 | 32 | 127.5 | 34.2 | 92 | 185.5 | 49.7 | 52 | 243.4 | 65.2 |
| 13 | 12.6 | 3.4 | 73 | 70.5 | 18.9 | 33 | 128.5 | 34.4 | 93 | 186.4 | 50.0 | 53 | 244.4 | 65.5 |
| 14 | 13.5 | 3.6 | 74 | 71.5 | 19.2 | 34 | 129.4 | 34.7 | 94 | 187.4 | 50.2 | 54 | 245.3 | 65.7 |
| 15 | 14.5 | 3.9 | 75 | 72.4 | 19.4 | 35 | 130.4 | 34.9 | 95 | 188.4 | 50.5 | 55 | 246.3 | 66.0 |
| 16 | 15.5 | 4.1 | 76 | 73.4 | 19.7 | 36 | 131.4 | 35.2 | 96 | 189.3 | 50.7 | 56 | 247.3 | 66.3 |
| 17 | 16.4 | 4.4 | 77 | 74.4 | 19.9 | 37 | 132.3 | 35.5 | 97 | 190.3 | 51.0 | 57 | 248.2 | 66.5 |
| 18 | 17.4 | 4.7 | 78 | 75.3 | 20.2 | 38 | 133.3 | 35.7 | 98 | 191.3 | 51.2 | 58 | 249.2 | 66.8 |
| 19 | 18.4 | 4.9 | 79 | 76.3 | 20.4 | 39 | 134.3 | 36.0 | 99 | 192.2 | 51.5 | 59 | 250.2 | 67.0 |
| 20 | 19.3 | 5.2 | 80 | 77.3 | 20.7 | 40 | 135.2 | 36.2 | 200 | 193.2 | 51.8 | 60 | 251.1 | 67.3 |
| 21 | 20.3 | 5.4 | 81 | 78.2 | 21.0 | 41 | 136.2 | 36.5 | 201 | 194.2 | 52.0 | 61 | 252.1 | 67.6 |
| 22 | 21.3 | 5.7 | 82 | 79.2 | 21.2 | 42 | 137.2 | 36.8 | 02 | 195.1 | 52.3 | 62 | 253.1 | 67.8 |
| 23 | 22.2 | 6.0 | 83 | 80.2 | 21.5 | 43 | 138.1 | 37.0 | 03 | 196.1 | 52.5 | 63 | 254.0 | 68.1 |
| 24 | 23.2 | 6.2 | 84 | 81.1 | 21.7 | 44 | 139.1 | 37.3 | 04 | 197.0 | 52.8 | 64 | 255.0 | 68.3 |
| 25 | 24.1 | 6.5 | 85 | 82.1 | 22.0 | 45 | 140.1 | 37.5 | 05 | 198.0 | 53.1 | 65 | 256.0 | 68.6 |
| 26 | 25.1 | 6.7 | 86 | 83.1 | 22.3 | 46 | 141.0 | 37.8 | 06 | 199.0 | 53.3 | 66 | 256.9 | 68.8 |
| 27 | 26.1 | 7.0 | 87 | 84.0 | 22.5 | 47 | 142.0 | 38.0 | 07 | 199.9 | 53.6 | 67 | 257.9 | 69.1 |
| 28 | 27.0 | 7.2 | 88 | 85.0 | 22.8 | 48 | 143.0 | 38.3 | 08 | 200.9 | 53.8 | 68 | 258.9 | 69.4 |
| 29 | 28.0 | 7.5 | 89 | 86.0 | 23.0 | 49 | 143.9 | 38.6 | 09 | 201.9 | 54.1 | 69 | 259.8 | 69.6 |
| 30 | 29.0 | 7.8 | 90 | 86.9 | 23.3 | 50 | 144.9 | 38.8 | 10 | 202.8 | 54.4 | 70 | 260.8 | 69.9 |
| 31 | 29.9 | 8.0 | 91 | 87.9 | 23.6 | 151 | 145.9 | 39.1 | 211 | 203.8 | 54.6 | 271 | 261.8 | 70.1 |
| 32 | 30.9 | 8.3 | 92 | 88.9 | 23.8 | 52 | 146.8 | 39.3 | 12 | 204.8 | 54.9 | 72 | 262.7 | 70.4 |
| 33 | 31.9 | 8.5 | 93 | 89.8 | 24.1 | 53 | 147.8 | 39.6 | 13 | 205.7 | 55.1 | 73 | 263.7 | 70.7 |
| 34 | 32.8 | 8.8 | 94 | 90.8 | 24.3 | 54 | 148.8 | 39.9 | 14 | 206.7 | 55.4 | 74 | 264.7 | 70.9 |
| 35 | 33.8 | 9.1 | 95 | 91.8 | 24.6 | 55 | 149.7 | 40.1 | 15 | 207.7 | 55.6 | 75 | 265.6 | 71.2 |
| 36 | 34.8 | 9.3 | 96 | 92.7 | 24.8 | 56 | 150.7 | 40.4 | 16 | 208.6 | 55.9 | 76 | 266.6 | 71.4 |
| 37 | 35.7 | 9.6 | 97 | 93.7 | 25.1 | 57 | 151.7 | 40.6 | 17 | 209.6 | 56.2 | 77 | 267.6 | 71.7 |
| 38 | 36.7 | 9.8 | 98 | 94.7 | 25.4 | 58 | 152.6 | 40.9 | 18 | 210.6 | 56.4 | 78 | 268.5 | 72.0 |
| 39 | 37.7 | 10.1 | 99 | 95.6 | 25.6 | 59 | 153.6 | 41.2 | 19 | 211.5 | 56.7 | 79 | 269.5 | 72.2 |
| 40 | 38.6 | 10.4 | 100 | 96.6 | 25.9 | 60 | 154.5 | 41.4 | 20 | 212.5 | 56.9 | 80 | 270.5 | 72.5 |
| 41 | 39.6 | 10.6 | 101 | 97.6 | 26.1 | 101 | 155.5 | 41.7 | 221 | 213.5 | 57.2 | 281 | 271.4 | 72.7 |
| 42 | 40.6 | 10.9 | 02 | 98.5 | 26.4 | 62 | 156.5 | 41.9 | 22 | 214.4 | 57.5 | 82 | 272.4 | 73.0 |
| 43 | 41.5 | 11.1 | 03 | 99.5 | 26.7 | 63 | 157.4 | 42.2 | 23 | 215.4 | 57.7 | 83 | 273.4 | 73.2 |
| 44 | 42.5 | 11.4 | 04 | 100.5 | 26.9 | 64 | 158.4 | 42.4 | 24 | 216.4 | 58.0 | 84 | 274.3 | 73.5 |
| 45 | 43.5 | 11.6 | 05 | 101.4 | 27.2 | 65 | 159.4 | 42.7 | 25 | 217.3 | 58.2 | 85 | 275.3 | 73.8 |
| 46 | 44.4 | 11.9 | 06 | 102.4 | 27.4 | 66 | 160.3 | 43.0 | 26 | 218.3 | 58.5 | 86 | 276.3 | 74.0 |
| 47 | 45.4 | 12.2 | 07 | 103.4 | 27.7 | 67 | 161.3 | 43.2 | 27 | 219.3 | 58.8 | 87 | 277.2 | 74.3 |
| 48 | 46.4 | 12.4 | 08 | 104.3 | 28.0 | 68 | 162.3 | 43.5 | 28 | 220.2 | 59.0 | 88 | 278.2 | 74.5 |
| 49 | 47.3 | 12.7 | 09 | 105.3 | 28.2 | 69 | 163.2 | 43.7 | 29 | 221.2 | 59.3 | 89 | 279.2 | 74.8 |
| 50 | 48.3 | 12.9 | 10 | 106.3 | 28.5 | 70 | 164.2 | 44.0 | 30 | 222.2 | 59.5 | 90 | 280.1 | 75.1 |
| 51 | 49.3 | 13.2 | 111 | 107.2 | 28.7 | 171 | 165.2 | 44.3 | 231 | 223.1 | 59.8 | 291 | 281.1 | 75.3 |
| 52 | 50.2 | 13.5 | 12 | 108.2 | 29.0 | 72 | 166.1 | 44.5 | 32 | 224.1 | 60.0 | 92 | 282.1 | 75.6 |
| 53 | 51.2 | 13.7 | 13 | 109.1 | 29.2 | 73 | 167.1 | 44.8 | 33 | 225.1 | 60.3 | 93 | 283.0 | 75.8 |
| 54 | 52.2 | 14.0 | 14 | 110.1 | 29.5 | 74 | 168.1 | 45.0 | 34 | 226.0 | 60.6 | 94 | 284.0 | 76.1 |
| 55 | 53.1 | 14.2 | 15 | 111.1 | 29.8 | 75 | 169.0 | 45.3 | 35 | 227.0 | 60.8 | 95 | 284.9 | 76.4 |
| 56 | 54.1 | 14.5 | 16 | 112.0 | 30.0 | 76 | 170.0 | 45.6 | 36 | 228.0 | 61.1 | 96 | 285.9 | 76.6 |
| 57 | 55.1 | 14.8 | 17 | 113.0 | 30.3 | 77 | 171.0 | 45.8 | 37 | 228.9 | 61.3 | 97 | 286.9 | 76.9 |
| 58 | 56.0 | 15.0 | 18 | 114.0 | 30.5 | 78 | 171.9 | 46.1 | 38 | 229.9 | 61.6 | 98 | 287.8 | 77.1 |
| 59 | 57.0 | 15.3 | 19 | 114.9 | 30.8 | 79 | 172.9 | 46.3 | 39 | 230.9 | 61.9 | 99 | 288.8 | 77.4 |
| 60 | 58.0 | 15.5 | 20 | 115.9 | 31.1 | 80 | 173.9 | 46.6 | 40 | 231.8 | 62.1 | 300 | 289.8 | 77.6 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|

[For 75 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 16°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.3 | 61 | 58.6 | 16.8 | 121 | 116.3 | 33.4 | 181 | 174.0 | 49.9 | 241 | 231.7 | 66.4 |
| 2 | 1.9 | 0.6 | 62 | 59.6 | 17.1 | 22 | 117.3 | 33.6 | 82 | 174.9 | 50.2 | 42 | 232.6 | 66.7 |
| 3 | 2.9 | 0.8 | 63 | 60.6 | 17.4 | 23 | 118.2 | 33.9 | 83 | 175.9 | 50.4 | 43 | 233.6 | 67.0 |
| 4 | 3.8 | 1.1 | 64 | 61.5 | 17.6 | 24 | 119.2 | 34.2 | 84 | 176.9 | 50.7 | 44 | 234.5 | 67.3 |
| 5 | 4.8 | 1.4 | 65 | 62.5 | 17.9 | 25 | 120.2 | 34.5 | 85 | 177.8 | 51.0 | 45 | 235.5 | 67.5 |
| 6 | 5.8 | 1.7 | 66 | 63.4 | 18.2 | 26 | 121.1 | 34.7 | 86 | 178.8 | 51.3 | 46 | 236.5 | 67.8 |
| 7 | 6.7 | 1.9 | 67 | 64.4 | 18.5 | 27 | 122.1 | 35.0 | 87 | 179.8 | 51.5 | 47 | 237.4 | 68.1 |
| 8 | 7.7 | 2.2 | 68 | 65.4 | 18.7 | 28 | 123.0 | 35.3 | 88 | 180.7 | 51.8 | 48 | 238.4 | 68.4 |
| 9 | 8.7 | 2.5 | 69 | 66.3 | 19.0 | 29 | 124.0 | 35.6 | 89 | 181.7 | 52.1 | 49 | 239.4 | 68.6 |
| 10 | 9.6 | 2.8 | 70 | 67.3 | 19.3 | 30 | 125.0 | 35.8 | 90 | 182.6 | 52.4 | 50 | 240.3 | 68.9 |
| 11 | 10.6 | 3.0 | 71 | 68.2 | 19.6 | 131 | 125.9 | 36.1 | 191 | 183.6 | 52.6 | 251 | 241.3 | 69.2 |
| 12 | 11.5 | 3.3 | 72 | 69.2 | 19.8 | 32 | 126.9 | 36.4 | 92 | 184.6 | 52.9 | 52 | 242.2 | 69.5 |
| 13 | 12.5 | 3.6 | 73 | 70.2 | 20.1 | 33 | 127.8 | 36.7 | 93 | 185.5 | 53.2 | 53 | 243.2 | 69.7 |
| 14 | 13.5 | 3.9 | 74 | 71.1 | 20.4 | 34 | 128.8 | 36.9 | 94 | 186.5 | 53.5 | 54 | 244.2 | 70.0 |
| 15 | 14.4 | 4.1 | 75 | 72.1 | 20.7 | 35 | 129.8 | 37.2 | 95 | 187.4 | 53.7 | 55 | 245.1 | 70.3 |
| 16 | 15.4 | 4.4 | 76 | 73.1 | 20.9 | 36 | 130.7 | 37.5 | 96 | 188.4 | 54.0 | 56 | 246.1 | 70.6 |
| 17 | 16.3 | 4.7 | 77 | 74.0 | 21.2 | 37 | 131.7 | 37.8 | 97 | 189.4 | 54.3 | 57 | 247.0 | 70.8 |
| 18 | 17.3 | 5.0 | 78 | 75.0 | 21.5 | 38 | 132.7 | 38.0 | 98 | 190.3 | 54.6 | 58 | 248.0 | 71.1 |
| 19 | 18.3 | 5.2 | 79 | 75.9 | 21.8 | 39 | 133.6 | 38.3 | 99 | 191.3 | 54.9 | 59 | 249.0 | 71.4 |
| 20 | 19.2 | 5.5 | 80 | 76.9 | 22.1 | 40 | 134.6 | 38.6 | 200 | 192.3 | 55.1 | 60 | 249.9 | 71.7 |
| 21 | 20.2 | 5.8 | 81 | 77.9 | 22.3 | 141 | 135.5 | 38.9 | 201 | 193.2 | 55.4 | 261 | 250.9 | 71.9 |
| 22 | 21.1 | 6.1 | 82 | 78.8 | 22.6 | 42 | 136.5 | 39.1 | 02 | 194.2 | 55.7 | 62 | 251.9 | 72.2 |
| 23 | 22.1 | 6.3 | 83 | 79.8 | 22.9 | 43 | 137.5 | 39.4 | 03 | 195.1 | 56.0 | 63 | 252.8 | 72.5 |
| 24 | 23.1 | 6.6 | 84 | 80.7 | 23.2 | 44 | 138.4 | 39.7 | 04 | 196.1 | 56.2 | 64 | 253.8 | 72.8 |
| 25 | 24.0 | 6.9 | 85 | 81.7 | 23.4 | 45 | 139.4 | 40.0 | 05 | 197.1 | 56.5 | 65 | 254.7 | 73.0 |
| 26 | 25.0 | 7.2 | 86 | 82.7 | 23.7 | 46 | 140.3 | 40.2 | 06 | 198.0 | 56.8 | 66 | 255.7 | 73.3 |
| 27 | 26.0 | 7.4 | 87 | 83.6 | 24.0 | 47 | 141.3 | 40.5 | 07 | 199.0 | 57.1 | 67 | 256.7 | 73.6 |
| 28 | 26.9 | 7.7 | 88 | 84.6 | 24.3 | 48 | 142.3 | 40.8 | 08 | 199.9 | 57.3 | 68 | 257.6 | 73.9 |
| 29 | 27.9 | 8.0 | 89 | 85.6 | 24.5 | 49 | 143.2 | 41.1 | 09 | 200.9 | 57.6 | 69 | 258.6 | 74.1 |
| 30 | 28.8 | 8.3 | 90 | 86.5 | 24.8 | 50 | 144.2 | 41.3 | 10 | 201.9 | 57.9 | 70 | 259.5 | 74.4 |
| 31 | 29.8 | 8.5 | 91 | 87.5 | 25.1 | 151 | 145.2 | 41.6 | 211 | 202.8 | 58.2 | 271 | 260.5 | 74.7 |
| 32 | 30.8 | 8.8 | 92 | 88.4 | 25.4 | 52 | 146.1 | 41.9 | 12 | 203.8 | 58.4 | 72 | 261.5 | 75.0 |
| 33 | 31.7 | 9.1 | 93 | 89.4 | 25.6 | 53 | 147.1 | 42.2 | 13 | 204.7 | 58.7 | 73 | 262.4 | 75.2 |
| 34 | 32.7 | 9.4 | 94 | 90.4 | 25.9 | 54 | 148.0 | 42.4 | 14 | 205.7 | 59.0 | 74 | 263.4 | 75.5 |
| 35 | 33.6 | 9.6 | 95 | 91.3 | 26.2 | 55 | 149.0 | 42.7 | 15 | 206.7 | 59.3 | 75 | 264.3 | 75.8 |
| 36 | 34.6 | 9.9 | 96 | 92.3 | 26.5 | 56 | 150.0 | 43.0 | 16 | 207.6 | 59.5 | 76 | 265.3 | 76.1 |
| 37 | 35.6 | 10.2 | 97 | 93.2 | 26.7 | 57 | 150.9 | 43.3 | 17 | 208.6 | 59.8 | 77 | 266.3 | 76.4 |
| 38 | 36.5 | 10.5 | 98 | 94.2 | 27.0 | 58 | 151.9 | 43.6 | 18 | 209.6 | 60.1 | 78 | 267.2 | 76.6 |
| 39 | 37.5 | 10.7 | 99 | 95.2 | 27.3 | 59 | 152.8 | 43.8 | 19 | 210.5 | 60.4 | 79 | 268.2 | 76.9 |
| 40 | 38.5 | 11.0 | 100 | 96.1 | 27.6 | 60 | 153.8 | 44.1 | 20 | 211.5 | 60.6 | 80 | 269.2 | 77.2 |
| 41 | 39.4 | 11.3 | 101 | 97.1 | 27.8 | 161 | 154.8 | 44.4 | 221 | 212.4 | 60.9 | 281 | 270.1 | 77.5 |
| 42 | 40.4 | 11.6 | 02 | 98.0 | 28.1 | 62 | 155.7 | 44.7 | 22 | 213.4 | 61.2 | 82 | 271.1 | 77.7 |
| 43 | 41.3 | 11.9 | 03 | 99.0 | 28.4 | 63 | 156.7 | 44.9 | 23 | 214.4 | 61.5 | 83 | 272.0 | 78.0 |
| 44 | 42.3 | 12.1 | 04 | 100.0 | 28.7 | 64 | 157.6 | 45.2 | 24 | 215.3 | 61.7 | 84 | 273.0 | 78.3 |
| 45 | 43.3 | 12.4 | 05 | 100.9 | 28.9 | 65 | 158.6 | 45.5 | 25 | 216.3 | 62.0 | 85 | 274.0 | 78.6 |
| 46 | 44.2 | 12.7 | 06 | 101.9 | 29.2 | 66 | 159.6 | 45.8 | 26 | 217.2 | 62.3 | 86 | 274.9 | 78.8 |
| 47 | 45.2 | 13.0 | 07 | 102.9 | 29.5 | 67 | 160.5 | 46.0 | 27 | 218.2 | 62.6 | 87 | 275.9 | 79.1 |
| 48 | 46.1 | 13.2 | 08 | 103.8 | 29.8 | 68 | 161.5 | 46.3 | 28 | 219.2 | 62.8 | 88 | 276.8 | 79.4 |
| 49 | 47.1 | 13.5 | 09 | 104.8 | 30.0 | 69 | 162.5 | 46.6 | 29 | 220.1 | 63.1 | 89 | 277.8 | 79.7 |
| 50 | 48.1 | 13.8 | 10 | 105.7 | 30.3 | 70 | 163.4 | 46.9 | 30 | 221.1 | 63.4 | 90 | 278.8 | 79.9 |
| 51 | 49.0 | 14.1 | 111 | 106.7 | 30.6 | 171 | 164.4 | 47.1 | 231 | 222.1 | 63.7 | 291 | 279.7 | 80.2 |
| 52 | 50.0 | 14.3 | 12 | 107.7 | 30.9 | 72 | 165.3 | 47.4 | 32 | 223.0 | 63.9 | 92 | 280.7 | 80.5 |
| 53 | 50.9 | 14.6 | 13 | 108.6 | 31.1 | 73 | 166.3 | 47.7 | 33 | 224.0 | 64.2 | 93 | 281.6 | 80.8 |
| 54 | 51.9 | 14.9 | 14 | 109.6 | 31.4 | 74 | 167.3 | 48.0 | 34 | 224.9 | 64.5 | 94 | 282.6 | 81.0 |
| 55 | 52.9 | 15.2 | 15 | 110.5 | 31.7 | 75 | 168.2 | 48.2 | 35 | 225.9 | 64.8 | 95 | 283.6 | 81.3 |
| 56 | 53.8 | 15.4 | 16 | 111.5 | 32.0 | 76 | 169.2 | 48.5 | 36 | 226.9 | 65.1 | 96 | 284.5 | 81.6 |
| 57 | 54.8 | 15.7 | 17 | 112.5 | 32.2 | 77 | 170.1 | 48.8 | 37 | 227.8 | 65.3 | 97 | 285.5 | 81.9 |
| 58 | 55.8 | 16.0 | 18 | 113.4 | 32.5 | 78 | 171.1 | 49.1 | 38 | 228.8 | 65.6 | 98 | 286.5 | 82.1 |
| 59 | 56.7 | 16.3 | 19 | 114.4 | 32.8 | 79 | 172.1 | 49.3 | 39 | 229.7 | 65.9 | 99 | 287.4 | 82.4 |
| 60 | 57.7 | 16.5 | 20 | 115.4 | 33.1 | 80 | 173.0 | 49.6 | 40 | 230.7 | 66.2 | 300 | 288.4 | 82.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 74 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 17°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.3 | 61 | 58.3 | 17.8 | 121 | 115.7 | 35.4 | 181 | 173.1 | 52.4 | 241 | 230.5 | 70.5 |
| 2 | 1.9 | 0.6 | 62 | 59.3 | 18.1 | 22 | 116.7 | 35.7 | 82 | 174.0 | 53.2 | 42 | 231.4 | 70.8 |
| 3 | 2.9 | 0.9 | 63 | 60.2 | 18.4 | 23 | 117.6 | 36.0 | 83 | 175.0 | 53.5 | 43 | 232.4 | 71.0 |
| 4 | 3.8 | 1.2 | 64 | 61.2 | 18.7 | 24 | 118.6 | 36.3 | 84 | 176.0 | 53.8 | 44 | 233.3 | 71.3 |
| 5 | 4.8 | 1.5 | 65 | 62.2 | 19.0 | 25 | 119.5 | 36.5 | 85 | 176.9 | 54.1 | 45 | 234.3 | 71.6 |
| 6 | 5.7 | 1.8 | 66 | 63.1 | 19.3 | 26 | 120.5 | 36.8 | 86 | 177.9 | 54.4 | 46 | 235.3 | 71.9 |
| 7 | 6.7 | 2.0 | 67 | 64.1 | 19.6 | 27 | 121.5 | 37.1 | 87 | 178.8 | 54.7 | 47 | 236.2 | 72.2 |
| 8 | 7.7 | 2.3 | 68 | 65.0 | 19.9 | 28 | 122.4 | 37.4 | 88 | 179.8 | 55.0 | 48 | 237.2 | 72.5 |
| 9 | 8.6 | 2.6 | 69 | 66.0 | 20.2 | 29 | 123.4 | 37.7 | 89 | 180.7 | 55.3 | 49 | 238.1 | 72.8 |
| 10 | 9.6 | 2.9 | 70 | 66.9 | 20.5 | 30 | 124.3 | 38.0 | 90 | 181.7 | 55.6 | 50 | 239.1 | 73.1 |
| 11 | 10.5 | 3.2 | 71 | 67.9 | 20.8 | 131 | 125.3 | 38.3 | 191 | 182.7 | 55.8 | 251 | 240.0 | 73.4 |
| 12 | 11.5 | 3.5 | 72 | 68.9 | 21.1 | 32 | 126.2 | 38.6 | 92 | 183.6 | 56.1 | 52 | 241.0 | 73.7 |
| 13 | 12.4 | 3.8 | 73 | 69.8 | 21.3 | 33 | 127.2 | 38.9 | 93 | 184.6 | 56.4 | 53 | 241.9 | 74.0 |
| 14 | 13.4 | 4.1 | 74 | 70.8 | 21.6 | 34 | 128.1 | 39.2 | 94 | 185.5 | 56.7 | 54 | 242.9 | 74.3 |
| 15 | 14.3 | 4.4 | 75 | 71.7 | 21.9 | 35 | 129.1 | 39.5 | 95 | 186.5 | 57.0 | 55 | 243.9 | 74.6 |
| 16 | 15.3 | 4.7 | 76 | 72.7 | 22.2 | 36 | 130.1 | 39.8 | 96 | 187.4 | 57.3 | 56 | 244.8 | 74.8 |
| 17 | 16.3 | 5.0 | 77 | 73.6 | 22.5 | 37 | 131.0 | 40.1 | 97 | 188.4 | 57.6 | 57 | 245.8 | 75.1 |
| 18 | 17.2 | 5.3 | 78 | 74.6 | 22.8 | 38 | 132.0 | 40.3 | 98 | 189.3 | 57.9 | 58 | 246.7 | 75.4 |
| 19 | 18.2 | 5.6 | 79 | 75.5 | 23.1 | 39 | 132.9 | 40.6 | 99 | 190.3 | 58.2 | 59 | 247.7 | 75.7 |
| 20 | 19.1 | 5.8 | 80 | 76.5 | 23.4 | 40 | 133.9 | 40.9 | 200 | 191.3 | 58.5 | 60 | 248.6 | 76.0 |
| 21 | 20.1 | 6.1 | 81 | 77.5 | 23.7 | 141 | 134.8 | 41.2 | 201 | 192.2 | 58.8 | 261 | 249.6 | 76.3 |
| 22 | 21.0 | 6.4 | 82 | 78.4 | 24.0 | 42 | 135.8 | 41.5 | 02 | 193.2 | 59.1 | 62 | 250.6 | 76.6 |
| 23 | 22.0 | 6.7 | 83 | 79.4 | 24.3 | 43 | 136.8 | 41.8 | 03 | 194.1 | 59.4 | 63 | 251.5 | 76.9 |
| 24 | 23.0 | 7.0 | 84 | 80.3 | 24.6 | 44 | 137.7 | 42.1 | 04 | 195.1 | 59.6 | 64 | 252.5 | 77.2 |
| 25 | 23.9 | 7.3 | 85 | 81.3 | 24.9 | 45 | 138.7 | 42.4 | 05 | 196.0 | 59.9 | 65 | 253.4 | 77.5 |
| 26 | 24.9 | 7.6 | 86 | 82.2 | 25.1 | 46 | 139.6 | 42.7 | 06 | 197.0 | 60.2 | 66 | 254.4 | 77.8 |
| 27 | 25.8 | 7.9 | 87 | 83.2 | 25.4 | 47 | 140.6 | 43.0 | 07 | 198.0 | 60.5 | 67 | 255.3 | 78.1 |
| 28 | 26.8 | 8.2 | 88 | 84.2 | 25.7 | 48 | 141.5 | 43.3 | 08 | 198.9 | 60.8 | 68 | 256.3 | 78.4 |
| 29 | 27.7 | 8.5 | 89 | 85.1 | 26.0 | 49 | 142.5 | 43.6 | 09 | 199.9 | 61.1 | 69 | 257.2 | 78.6 |
| 30 | 28.7 | 8.8 | 90 | 86.1 | 26.3 | 50 | 143.4 | 43.9 | 10 | 200.8 | 61.4 | 70 | 258.2 | 78.9 |
| 31 | 29.6 | 9.1 | 91 | 87.0 | 26.6 | 151 | 144.4 | 44.1 | 211 | 201.8 | 61.7 | 271 | 259.2 | 79.2 |
| 32 | 30.6 | 9.4 | 92 | 88.0 | 26.9 | 52 | 145.4 | 44.4 | 12 | 202.7 | 62.0 | 72 | 260.1 | 79.5 |
| 33 | 31.6 | 9.6 | 93 | 88.9 | 27.2 | 53 | 146.3 | 44.7 | 13 | 203.7 | 62.3 | 73 | 261.1 | 79.8 |
| 34 | 32.5 | 9.9 | 94 | 89.9 | 27.5 | 54 | 147.3 | 45.0 | 14 | 204.6 | 62.6 | 74 | 262.0 | 80.1 |
| 35 | 33.5 | 10.2 | 95 | 90.8 | 27.8 | 55 | 148.2 | 45.3 | 15 | 205.6 | 62.9 | 75 | 263.0 | 80.4 |
| 36 | 34.4 | 10.5 | 96 | 91.8 | 28.1 | 56 | 149.2 | 45.6 | 16 | 206.6 | 63.2 | 76 | 263.9 | 80.7 |
| 37 | 35.4 | 10.8 | 97 | 92.8 | 28.4 | 57 | 150.1 | 45.9 | 17 | 207.5 | 63.4 | 77 | 264.9 | 81.0 |
| 38 | 36.3 | 11.1 | 98 | 93.7 | 28.7 | 58 | 151.1 | 46.2 | 18 | 208.5 | 63.7 | 78 | 265.9 | 81.3 |
| 39 | 37.3 | 11.4 | 99 | 94.7 | 28.9 | 59 | 152.1 | 46.5 | 19 | 209.4 | 64.0 | 79 | 266.8 | 81.6 |
| 40 | 38.3 | 11.7 | 100 | 95.6 | 29.2 | 60 | 153.0 | 46.8 | 20 | 210.4 | 64.3 | 80 | 267.8 | 81.9 |
| 41 | 39.2 | 12.0 | 101 | 96.6 | 29.5 | 161 | 154.0 | 47.1 | 221 | 211.3 | 64.6 | 281 | 268.7 | 82.2 |
| 42 | 40.2 | 12.3 | 02 | 97.5 | 29.8 | 62 | 154.9 | 47.4 | 22 | 212.3 | 64.9 | 82 | 269.7 | 82.4 |
| 43 | 41.1 | 12.6 | 03 | 98.5 | 30.1 | 63 | 155.9 | 47.7 | 23 | 213.3 | 65.2 | 83 | 270.6 | 82.7 |
| 44 | 42.1 | 12.9 | 04 | 99.5 | 30.4 | 64 | 156.8 | 47.9 | 24 | 214.2 | 65.5 | 84 | 271.6 | 83.0 |
| 45 | 43.0 | 13.2 | 05 | 100.4 | 30.7 | 65 | 157.8 | 48.2 | 25 | 215.2 | 65.8 | 85 | 272.5 | 83.3 |
| 46 | 44.0 | 13.4 | 06 | 101.4 | 31.0 | 66 | 158.7 | 48.5 | 26 | 216.1 | 66.1 | 86 | 273.5 | 83.6 |
| 47 | 44.9 | 13.7 | 07 | 102.3 | 31.3 | 67 | 159.7 | 48.8 | 27 | 217.1 | 66.4 | 87 | 274.5 | 83.9 |
| 48 | 45.9 | 14.0 | 08 | 103.3 | 31.6 | 68 | 160.7 | 49.1 | 28 | 218.0 | 66.7 | 88 | 275.4 | 84.2 |
| 49 | 46.9 | 14.3 | 09 | 104.2 | 31.9 | 69 | 161.6 | 49.4 | 29 | 219.0 | 67.0 | 89 | 276.4 | 84.5 |
| 50 | 47.8 | 14.6 | 10 | 105.2 | 32.2 | 70 | 162.6 | 49.7 | 30 | 220.0 | 67.3 | 90 | 277.3 | 84.8 |
| 51 | 48.8 | 14.9 | 111 | 106.1 | 32.5 | 171 | 163.5 | 50.0 | 231 | 220.9 | 67.5 | 291 | 278.3 | 85.1 |
| 52 | 49.7 | 15.2 | 12 | 107.1 | 32.7 | 72 | 164.5 | 50.3 | 32 | 221.9 | 67.8 | 92 | 279.2 | 85.4 |
| 53 | 50.7 | 15.5 | 13 | 108.1 | 33.9 | 73 | 165.4 | 50.6 | 33 | 222.8 | 68.1 | 93 | 280.2 | 85.7 |
| 54 | 51.6 | 15.8 | 14 | 109.0 | 33.3 | 74 | 166.4 | 50.9 | 34 | 223.8 | 68.4 | 94 | 281.2 | 86.0 |
| 55 | 52.6 | 16.1 | 15 | 110.0 | 33.6 | 75 | 167.4 | 51.2 | 35 | 224.7 | 68.7 | 95 | 282.1 | 86.3 |
| 56 | 53.6 | 16.4 | 16 | 110.9 | 33.9 | 76 | 168.3 | 51.5 | 36 | 225.7 | 69.0 | 96 | 283.1 | 86.6 |
| 57 | 54.5 | 16.7 | 17 | 111.9 | 34.2 | 77 | 169.3 | 51.7 | 37 | 226.6 | 69.3 | 97 | 284.0 | 86.8 |
| 58 | 55.5 | 17.0 | 18 | 112.8 | 34.5 | 78 | 170.2 | 52.0 | 38 | 227.6 | 69.6 | 98 | 285.0 | 87.1 |
| 59 | 56.4 | 17.2 | 19 | 113.8 | 34.8 | 79 | 171.2 | 52.3 | 39 | 228.6 | 69.9 | 99 | 285.9 | 87.4 |
| 60 | 57.4 | 17.5 | 20 | 114.8 | 35.1 | 80 | 172.1 | 52.6 | 40 | 229.5 | 70.2 | 300 | 286.9 | 87.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 73] Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 18°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 1.0 | 0.3 | 61 | 58.0 | 18.9 | 121 | 115.1 | 37.4 | 181 | 172.1 | 55.9 | 241 | 229.2 | 74.5 |
| 2 | 1.9 | 0.6 | 62 | 59.0 | 19.2 | 22 | 116.0 | 37.7 | 82 | 173.1 | 56.2 | 42 | 230.2 | 74.8 |
| 3 | 2.9 | 0.9 | 63 | 59.9 | 19.5 | 23 | 117.0 | 38.0 | 83 | 174.0 | 56.6 | 43 | 231.1 | 75.1 |
| 4 | 3.8 | 1.2 | 64 | 60.9 | 19.8 | 24 | 117.9 | 38.3 | 84 | 175.0 | 56.9 | 44 | 232.1 | 75.4 |
| 5 | 4.8 | 1.5 | 65 | 61.8 | 20.1 | 25 | 118.9 | 38.6 | 85 | 175.9 | 57.2 | 45 | 233.0 | 75.7 |
| 6 | 5.7 | 1.9 | 66 | 62.8 | 20.4 | 26 | 119.8 | 38.9 | 86 | 176.9 | 57.5 | 46 | 234.0 | 76.0 |
| 7 | 6.7 | 2.2 | 67 | 63.7 | 20.7 | 27 | 120.8 | 39.2 | 87 | 177.8 | 57.8 | 47 | 234.9 | 76.3 |
| 8 | 7.6 | 2.5 | 68 | 64.7 | 21.0 | 28 | 121.7 | 39.6 | 88 | 178.8 | 58.1 | 48 | 235.9 | 76.6 |
| 9 | 8.6 | 2.8 | 69 | 65.6 | 21.3 | 29 | 122.7 | 39.9 | 89 | 179.7 | 58.4 | 49 | 236.8 | 76.9 |
| 10 | 9.5 | 3.1 | 70 | 66.6 | 21.6 | 30 | 123.6 | 40.2 | 90 | 180.7 | 58.7 | 50 | 237.8 | 77.3 |
| 11 | 10.5 | 3.4 | 71 | 67.5 | 21.9 | 131 | 124.6 | 40.5 | 191 | 181.7 | 59.0 | 251 | 238.7 | 77.6 |
| 12 | 11.4 | 3.7 | 72 | 68.5 | 22.2 | 32 | 125.5 | 40.8 | 92 | 182.6 | 59.3 | 52 | 239.7 | 77.9 |
| 13 | 12.4 | 4.0 | 73 | 69.4 | 22.6 | 33 | 126.5 | 41.1 | 93 | 183.6 | 59.6 | 53 | 240.6 | 78.2 |
| 14 | 13.3 | 4.3 | 74 | 70.4 | 22.9 | 34 | 127.4 | 41.4 | 94 | 184.5 | 59.9 | 54 | 241.6 | 78.5 |
| 15 | 14.3 | 4.6 | 75 | 71.3 | 23.2 | 35 | 128.4 | 41.7 | 95 | 185.5 | 60.3 | 55 | 242.5 | 78.8 |
| 16 | 15.2 | 4.9 | 76 | 72.3 | 23.5 | 36 | 129.3 | 42.0 | 96 | 186.4 | 60.6 | 56 | 243.5 | 79.1 |
| 17 | 16.2 | 5.3 | 77 | 73.2 | 23.8 | 37 | 130.3 | 42.3 | 97 | 187.4 | 60.9 | 57 | 244.4 | 79.4 |
| 18 | 17.1 | 5.6 | 78 | 74.2 | 24.1 | 38 | 131.2 | 42.6 | 98 | 188.3 | 61.2 | 58 | 245.4 | 79.7 |
| 19 | 18.1 | 5.9 | 79 | 75.1 | 24.4 | 39 | 132.2 | 43.0 | 99 | 189.3 | 61.5 | 59 | 246.3 | 80.0 |
| 20 | 19.0 | 6.2 | 80 | 76.1 | 24.7 | 40 | 133.1 | 43.3 | 200 | 190.2 | 61.8 | 60 | 247.3 | 80.3 |
| 21 | 20.0 | 6.5 | 81 | 77.0 | 25.0 | 141 | 134.1 | 43.6 | 201 | 191.2 | 62.1 | 261 | 248.2 | 80.7 |
| 22 | 20.9 | 6.8 | 82 | 78.0 | 25.3 | 42 | 135.1 | 43.9 | 02 | 192.1 | 62.4 | 62 | 249.2 | 81.0 |
| 23 | 21.9 | 7.1 | 83 | 78.9 | 25.6 | 43 | 136.0 | 44.2 | 03 | 193.1 | 62.7 | 63 | 250.1 | 81.3 |
| 24 | 22.8 | 7.4 | 84 | 79.9 | 26.0 | 44 | 137.0 | 44.5 | 04 | 194.0 | 63.0 | 64 | 251.1 | 81.6 |
| 25 | 23.8 | 7.7 | 85 | 80.8 | 26.3 | 45 | 137.9 | 44.8 | 05 | 195.0 | 63.3 | 65 | 252.0 | 81.9 |
| 26 | 24.7 | 8.0 | 86 | 81.8 | 26.6 | 46 | 138.9 | 45.1 | 06 | 195.9 | 63.7 | 66 | 253.0 | 82.2 |
| 27 | 25.7 | 8.3 | 87 | 82.7 | 26.9 | 47 | 139.8 | 45.4 | 07 | 196.9 | 64.0 | 67 | 253.9 | 82.5 |
| 28 | 26.6 | 8.7 | 88 | 83.7 | 27.2 | 48 | 140.8 | 45.7 | 08 | 197.8 | 64.3 | 68 | 254.9 | 82.8 |
| 29 | 27.6 | 9.0 | 89 | 84.6 | 27.5 | 49 | 141.7 | 46.0 | 09 | 198.8 | 64.6 | 69 | 255.8 | 83.1 |
| 30 | 28.5 | 9.3 | 90 | 85.6 | 27.8 | 50 | 142.7 | 46.4 | 10 | 199.7 | 64.9 | 70 | 256.8 | 83.4 |
| 31 | 29.5 | 9.6 | 91 | 86.5 | 28.1 | 151 | 143.6 | 46.7 | 211 | 200.7 | 65.2 | 271 | 257.7 | 83.7 |
| 32 | 30.4 | 9.9 | 92 | 87.5 | 28.4 | 52 | 144.6 | 47.0 | 12 | 201.6 | 65.5 | 72 | 258.7 | 84.1 |
| 33 | 31.4 | 10.2 | 93 | 88.4 | 28.7 | 53 | 145.5 | 47.3 | 13 | 202.6 | 65.8 | 73 | 259.6 | 84.4 |
| 34 | 32.3 | 10.5 | 94 | 89.4 | 29.0 | 54 | 146.5 | 47.6 | 14 | 203.5 | 66.1 | 74 | 260.6 | 84.7 |
| 35 | 33.3 | 10.8 | 95 | 90.4 | 29.4 | 55 | 147.4 | 47.9 | 15 | 204.5 | 66.4 | 75 | 261.5 | 85.0 |
| 36 | 34.2 | 11.1 | 96 | 91.3 | 29.7 | 56 | 148.4 | 48.2 | 16 | 205.4 | 66.7 | 76 | 262.5 | 85.3 |
| 37 | 35.2 | 11.4 | 97 | 92.3 | 30.0 | 57 | 149.3 | 48.5 | 17 | 206.4 | 67.1 | 77 | 263.4 | 85.6 |
| 38 | 36.1 | 11.7 | 98 | 93.2 | 30.3 | 58 | 150.3 | 48.8 | 18 | 207.3 | 67.4 | 78 | 264.4 | 85.9 |
| 39 | 37.1 | 12.1 | 99 | 94.2 | 30.6 | 59 | 151.2 | 49.1 | 19 | 208.3 | 67.7 | 79 | 265.3 | 86.2 |
| 40 | 38.0 | 12.4 | 100 | 95.1 | 30.9 | 60 | 152.2 | 49.4 | 20 | 209.2 | 68.0 | 80 | 266.3 | 86.5 |
| 41 | 39.0 | 12.7 | 101 | 96.1 | 31.2 | 161 | 153.1 | 49.8 | 221 | 210.2 | 68.3 | 281 | 267.2 | 86.8 |
| 42 | 39.9 | 13.0 | 02 | 97.0 | 31.5 | 62 | 154.1 | 50.1 | 22 | 211.1 | 68.6 | 82 | 268.2 | 87.1 |
| 43 | 40.9 | 13.3 | 03 | 98.0 | 31.8 | 63 | 155.0 | 50.4 | 23 | 212.1 | 68.9 | 83 | 269.1 | 87.5 |
| 44 | 41.8 | 13.6 | 04 | 98.9 | 32.1 | 64 | 156.0 | 50.7 | 24 | 213.0 | 69.2 | 84 | 270.1 | 87.8 |
| 45 | 42.8 | 13.9 | 05 | 99.9 | 32.4 | 65 | 156.9 | 51.0 | 25 | 214.0 | 69.5 | 85 | 271.1 | 88.1 |
| 46 | 43.7 | 14.2 | 06 | 100.8 | 32.8 | 66 | 157.9 | 51.3 | 26 | 214.9 | 69.8 | 86 | 272.0 | 88.4 |
| 47 | 44.7 | 14.5 | 07 | 101.8 | 33.1 | 67 | 158.8 | 51.6 | 27 | 215.9 | 70.1 | 87 | 273.0 | 88.7 |
| 48 | 45.7 | 14.8 | 08 | 102.7 | 33.4 | 68 | 159.8 | 51.9 | 28 | 216.8 | 70.5 | 88 | 273.9 | 89.0 |
| 49 | 46.6 | 15.1 | 09 | 103.7 | 33.7 | 69 | 160.7 | 52.2 | 29 | 217.8 | 70.8 | 89 | 274.9 | 89.3 |
| 50 | 47.6 | 15.5 | 10 | 104.6 | 34.0 | 70 | 161.7 | 52.5 | 30 | 218.7 | 71.1 | 90 | 275.8 | 89.6 |
| 51 | 48.5 | 15.8 | 111 | 105.6 | 34.3 | 171 | 162.6 | 52.8 | 231 | 219.7 | 71.4 | 291 | 276.8 | 89.9 |
| 52 | 49.5 | 16.1 | 12 | 106.5 | 34.6 | 72 | 163.6 | 53.2 | 32 | 220.6 | 71.7 | 92 | 277.7 | 90.2 |
| 53 | 50.4 | 16.4 | 13 | 107.5 | 34.9 | 73 | 164.5 | 53.5 | 33 | 221.6 | 72.0 | 93 | 278.7 | 90.5 |
| 54 | 51.4 | 16.7 | 14 | 108.4 | 35.2 | 74 | 165.5 | 53.8 | 34 | 222.5 | 72.3 | 94 | 279.6 | 90.9 |
| 55 | 52.3 | 17.0 | 15 | 109.4 | 35.5 | 75 | 166.4 | 54.1 | 35 | 223.5 | 72.6 | 95 | 280.6 | 91.2 |
| 56 | 53.3 | 17.3 | 16 | 110.3 | 35.8 | 76 | 167.4 | 54.4 | 36 | 224.4 | 72.9 | 96 | 281.5 | 91.5 |
| 57 | 54.2 | 17.6 | 17 | 111.3 | 36.2 | 77 | 168.3 | 54.7 | 37 | 225.4 | 73.2 | 97 | 282.5 | 91.8 |
| 58 | 55.2 | 17.9 | 18 | 112.2 | 36.5 | 78 | 169.3 | 55.0 | 38 | 226.4 | 73.5 | 98 | 283.4 | 92.1 |
| 59 | 56.1 | 18.2 | 19 | 113.2 | 36.8 | 79 | 170.2 | 55.3 | 39 | 227.3 | 73.9 | 99 | 284.4 | 92.4 |
| 60 | 57.1 | 18.5 | 20 | 114.1 | 37.1 | 80 | 171.2 | 55.6 | 40 | 228.3 | 74.2 | 300 | 285.3 | 92.7 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|

[For 72 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 19°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|
| 1 | 0.9 | 0.3 | 61 | 57.7 | 19.9 | 121 | 114.4 | 39.4 | 181 | 171.1 | 58.9 | 241 | 227.9 | 78.5 |
| 2 | 1.9 | 0.7 | 62 | 58.6 | 20.2 | 22 | 115.4 | 39.7 | 82 | 172.1 | 59.3 | 42 | 228.8 | 78.8 |
| 3 | 2.8 | 1.0 | 63 | 59.6 | 20.5 | 23 | 116.3 | 40.0 | 83 | 173.0 | 59.6 | 43 | 229.8 | 79.1 |
| 4 | 3.8 | 1.3 | 64 | 60.5 | 20.8 | 24 | 117.2 | 40.4 | 84 | 174.0 | 59.9 | 44 | 230.7 | 79.4 |
| 5 | 4.7 | 1.6 | 65 | 61.5 | 21.2 | 25 | 118.2 | 40.7 | 85 | 174.9 | 60.2 | 45 | 231.7 | 79.8 |
| 6 | 5.7 | 2.0 | 66 | 62.4 | 21.5 | 26 | 119.1 | 41.0 | 86 | 175.9 | 60.6 | 46 | 232.6 | 80.1 |
| 7 | 6.6 | 2.3 | 67 | 63.3 | 21.8 | 27 | 120.1 | 41.3 | 87 | 176.8 | 60.9 | 47 | 233.5 | 80.4 |
| 8 | 7.6 | 2.6 | 68 | 64.3 | 22.1 | 28 | 121.0 | 41.7 | 88 | 177.8 | 61.2 | 48 | 234.5 | 80.7 |
| 9 | 8.5 | 2.9 | 69 | 65.2 | 22.5 | 29 | 122.0 | 42.0 | 89 | 178.7 | 61.5 | 49 | 235.4 | 81.1 |
| 10 | 9.5 | 3.3 | 70 | 66.2 | 22.8 | 30 | 122.9 | 42.3 | 90 | 179.6 | 61.9 | 50 | 236.4 | 81.4 |
| 11 | 10.4 | 3.6 | 71 | 67.1 | 23.1 | 131 | 123.9 | 42.6 | 191 | 180.6 | 62.2 | 251 | 237.3 | 81.7 |
| 12 | 11.3 | 3.9 | 72 | 68.1 | 23.4 | 32 | 124.8 | 43.0 | 92 | 181.5 | 62.5 | 52 | 238.3 | 82.0 |
| 13 | 12.3 | 4.2 | 73 | 69.0 | 23.8 | 33 | 125.8 | 43.3 | 93 | 182.5 | 62.8 | 53 | 239.2 | 82.4 |
| 14 | 13.2 | 4.6 | 74 | 70.0 | 24.1 | 34 | 126.7 | 43.6 | 94 | 183.4 | 63.2 | 54 | 240.2 | 82.7 |
| 15 | 14.2 | 4.9 | 75 | 70.9 | 24.4 | 35 | 127.6 | 44.0 | 95 | 184.4 | 63.5 | 55 | 241.1 | 83.0 |
| 16 | 15.1 | 5.2 | 76 | 71.9 | 24.7 | 36 | 128.6 | 44.3 | 96 | 185.3 | 63.8 | 56 | 242.1 | 83.3 |
| 17 | 16.1 | 5.5 | 77 | 72.8 | 25.1 | 37 | 129.5 | 44.6 | 97 | 186.3 | 64.1 | 57 | 243.0 | 83.7 |
| 18 | 17.0 | 5.9 | 78 | 73.8 | 25.4 | 38 | 130.5 | 44.9 | 98 | 187.2 | 64.5 | 58 | 243.9 | 84.0 |
| 19 | 18.0 | 6.2 | 79 | 74.7 | 25.7 | 39 | 131.4 | 45.3 | 99 | 188.2 | 64.8 | 59 | 244.9 | 84.3 |
| 20 | 18.9 | 6.5 | 80 | 75.6 | 26.0 | 40 | 132.4 | 45.6 | 200 | 189.1 | 65.1 | 60 | 245.8 | 84.6 |
| 21 | 19.9 | 6.8 | 81 | 76.6 | 26.4 | 141 | 133.3 | 45.9 | 201 | 190.0 | 65.4 | 261 | 246.8 | 85.0 |
| 22 | 20.8 | 7.2 | 82 | 77.5 | 26.7 | 42 | 134.3 | 46.2 | 02 | 191.0 | 65.8 | 62 | 247.7 | 85.3 |
| 23 | 21.7 | 7.5 | 83 | 78.5 | 27.0 | 43 | 135.2 | 46.6 | 03 | 191.9 | 66.1 | 63 | 248.7 | 85.6 |
| 24 | 22.7 | 7.8 | 84 | 79.4 | 27.3 | 44 | 136.2 | 46.9 | 04 | 192.9 | 66.4 | 64 | 249.6 | 86.0 |
| 25 | 23.6 | 8.1 | 85 | 80.4 | 27.7 | 45 | 137.1 | 47.2 | 05 | 193.8 | 66.7 | 65 | 250.6 | 86.3 |
| 26 | 24.6 | 8.5 | 86 | 81.3 | 28.0 | 46 | 138.0 | 47.5 | 06 | 194.8 | 67.1 | 66 | 251.5 | 86.6 |
| 27 | 25.5 | 8.8 | 87 | 82.3 | 28.3 | 47 | 139.0 | 47.9 | 07 | 195.7 | 67.4 | 67 | 252.5 | 86.9 |
| 28 | 26.5 | 9.1 | 88 | 83.2 | 28.7 | 48 | 139.9 | 48.2 | 08 | 196.7 | 67.7 | 68 | 253.4 | 87.3 |
| 29 | 27.4 | 9.4 | 89 | 84.2 | 29.0 | 49 | 140.9 | 48.5 | 09 | 197.6 | 68.0 | 69 | 254.3 | 87.6 |
| 30 | 28.4 | 9.8 | 90 | 85.1 | 29.3 | 50 | 141.8 | 48.8 | 10 | 198.6 | 68.4 | 70 | 255.3 | 87.9 |
| 31 | 29.3 | 10.1 | 91 | 86.0 | 29.6 | 151 | 142.8 | 49.2 | 211 | 199.5 | 68.7 | 271 | 256.2 | 88.2 |
| 32 | 30.3 | 10.4 | 92 | 87.0 | 30.0 | 52 | 143.7 | 49.5 | 12 | 200.4 | 69.0 | 72 | 257.2 | 88.6 |
| 33 | 31.2 | 10.7 | 93 | 87.9 | 30.3 | 53 | 144.7 | 49.8 | 13 | 201.4 | 69.3 | 73 | 258.1 | 88.9 |
| 34 | 32.1 | 11.1 | 94 | 88.9 | 30.6 | 54 | 145.6 | 50.1 | 14 | 202.3 | 69.7 | 74 | 259.1 | 89.2 |
| 35 | 33.1 | 11.4 | 95 | 89.8 | 30.9 | 55 | 146.6 | 50.5 | 15 | 203.3 | 70.0 | 75 | 260.0 | 89.5 |
| 36 | 34.0 | 11.7 | 96 | 90.8 | 31.3 | 56 | 147.5 | 50.8 | 16 | 204.2 | 70.3 | 76 | 261.0 | 89.9 |
| 37 | 35.0 | 12.0 | 97 | 91.7 | 31.6 | 57 | 148.4 | 51.1 | 17 | 205.2 | 70.6 | 77 | 261.9 | 90.2 |
| 38 | 35.9 | 12.4 | 98 | 92.7 | 31.9 | 58 | 149.4 | 51.4 | 18 | 206.1 | 71.0 | 78 | 262.9 | 90.5 |
| 39 | 36.9 | 12.7 | 99 | 93.6 | 32.2 | 59 | 150.3 | 51.8 | 19 | 207.1 | 71.3 | 79 | 263.8 | 90.8 |
| 40 | 37.8 | 13.0 | 100 | 94.6 | 32.6 | 60 | 151.3 | 52.1 | 20 | 208.0 | 71.6 | 80 | 264.7 | 91.2 |
| 41 | 38.8 | 13.3 | 101 | 95.5 | 32.9 | 161 | 152.2 | 52.4 | 221 | 209.0 | 72.0 | 281 | 265.7 | 91.5 |
| 42 | 39.7 | 13.7 | 02 | 96.4 | 33.2 | 62 | 153.2 | 52.7 | 22 | 209.9 | 72.3 | 82 | 266.6 | 91.8 |
| 43 | 40.7 | 14.0 | 03 | 97.4 | 33.5 | 63 | 154.1 | 53.1 | 23 | 210.9 | 72.6 | 83 | 267.6 | 92.1 |
| 44 | 41.6 | 14.3 | 04 | 98.3 | 33.9 | 64 | 155.1 | 53.4 | 24 | 211.8 | 72.9 | 84 | 268.5 | 92.5 |
| 45 | 42.5 | 14.7 | 05 | 99.3 | 34.2 | 65 | 156.0 | 53.7 | 25 | 212.7 | 73.3 | 85 | 269.5 | 92.8 |
| 46 | 43.5 | 15.0 | 06 | 100.2 | 34.5 | 66 | 157.0 | 54.0 | 26 | 213.7 | 73.6 | 86 | 270.4 | 93.1 |
| 47 | 44.4 | 15.3 | 07 | 101.2 | 34.8 | 67 | 157.9 | 54.4 | 27 | 214.6 | 73.9 | 87 | 271.4 | 93.4 |
| 48 | 45.4 | 15.6 | 08 | 102.1 | 35.2 | 68 | 158.8 | 54.7 | 28 | 215.6 | 74.2 | 88 | 272.3 | 93.8 |
| 49 | 46.3 | 16.0 | 09 | 103.1 | 35.5 | 69 | 159.8 | 55.0 | 29 | 216.5 | 74.6 | 89 | 273.3 | 94.1 |
| 50 | 47.3 | 16.3 | 10 | 104.0 | 35.8 | 70 | 160.7 | 55.3 | 30 | 217.5 | 74.9 | 90 | 274.2 | 94.4 |
| 51 | 48.2 | 16.6 | 111 | 105.0 | 36.1 | 171 | 161.7 | 55.7 | 231 | 218.4 | 75.2 | 291 | 275.1 | 94.7 |
| 52 | 49.2 | 16.9 | 12 | 105.9 | 36.5 | 72 | 162.6 | 56.0 | 32 | 219.4 | 75.5 | 92 | 276.1 | 95.1 |
| 53 | 50.1 | 17.3 | 13 | 106.8 | 36.8 | 73 | 163.6 | 56.3 | 33 | 220.3 | 75.9 | 93 | 277.0 | 95.4 |
| 54 | 51.1 | 17.6 | 14 | 107.8 | 37.1 | 74 | 164.5 | 56.6 | 34 | 221.3 | 76.2 | 94 | 278.0 | 95.7 |
| 55 | 52.0 | 17.9 | 15 | 108.7 | 37.4 | 75 | 165.5 | 57.0 | 35 | 222.2 | 76.5 | 95 | 278.9 | 96.0 |
| 56 | 52.9 | 18.2 | 16 | 109.7 | 37.8 | 76 | 166.4 | 57.3 | 36 | 223.1 | 76.8 | 96 | 279.9 | 96.4 |
| 57 | 53.9 | 18.6 | 17 | 110.6 | 38.1 | 77 | 167.4 | 57.6 | 37 | 224.1 | 77.2 | 97 | 280.8 | 96.7 |
| 58 | 54.8 | 18.9 | 18 | 111.6 | 38.4 | 78 | 168.3 | 58.0 | 38 | 225.0 | 77.5 | 98 | 281.8 | 97.0 |
| 59 | 55.8 | 19.2 | 19 | 112.5 | 38.7 | 79 | 169.2 | 58.3 | 39 | 226.0 | 77.8 | 99 | 282.7 | 97.3 |
| 60 | 56.7 | 19.5 | 20 | 113.5 | 39.1 | 80 | 170.2 | 58.6 | 40 | 226.9 | 78.1 | 300 | 283.7 | 97.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 71 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 20°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|-------|
| 1 | 0.9 | 0.3 | 61 | 57.3 | 20.9 | 121 | 113.7 | 41.4 | 181 | 170.1 | 61.9 | 241 | 226.5 | 82.4 |
| 2 | 1.9 | 0.7 | 62 | 58.3 | 21.2 | 23 | 114.6 | 41.7 | 82 | 171.0 | 62.2 | 42 | 227.4 | 82.8 |
| 3 | 2.8 | 1.0 | 63 | 59.2 | 21.5 | 23 | 115.6 | 42.1 | 83 | 172.0 | 62.6 | 43 | 228.3 | 83.1 |
| 4 | 3.8 | 1.4 | 64 | 60.1 | 21.9 | 24 | 116.5 | 42.4 | 84 | 172.9 | 62.9 | 44 | 229.3 | 83.5 |
| 5 | 4.7 | 1.7 | 65 | 61.1 | 22.2 | 25 | 117.5 | 42.8 | 85 | 173.8 | 63.3 | 45 | 230.2 | 83.8 |
| 6 | 5.6 | 2.1 | 66 | 62.0 | 22.6 | 26 | 118.4 | 43.1 | 86 | 174.8 | 63.6 | 46 | 231.2 | 84.1 |
| 7 | 6.6 | 2.4 | 67 | 63.0 | 22.9 | 27 | 119.3 | 43.4 | 87 | 175.7 | 64.0 | 47 | 232.1 | 84.5 |
| 8 | 7.5 | 2.7 | 68 | 63.9 | 23.3 | 28 | 120.3 | 43.8 | 88 | 176.7 | 64.3 | 48 | 233.0 | 84.8 |
| 9 | 8.5 | 3.1 | 69 | 64.8 | 23.6 | 29 | 121.2 | 44.1 | 89 | 177.6 | 64.6 | 49 | 234.0 | 85.2 |
| 10 | 9.4 | 3.4 | 70 | 65.8 | 23.9 | 30 | 122.2 | 44.5 | 90 | 178.5 | 65.0 | 50 | 234.9 | 85.5 |
| 11 | 10.3 | 3.8 | 71 | 66.7 | 24.3 | 131 | 123.1 | 44.8 | 191 | 179.5 | 65.3 | 251 | 235.9 | 85.8 |
| 12 | 11.3 | 4.1 | 72 | 67.7 | 24.6 | 32 | 124.0 | 45.1 | 92 | 180.4 | 65.7 | 52 | 236.8 | 86.2 |
| 13 | 12.2 | 4.4 | 73 | 68.6 | 25.0 | 33 | 125.0 | 45.5 | 93 | 181.4 | 66.0 | 53 | 237.7 | 86.5 |
| 14 | 13.2 | 4.8 | 74 | 69.5 | 25.3 | 34 | 125.9 | 45.8 | 94 | 182.3 | 66.4 | 54 | 238.7 | 86.9 |
| 15 | 14.1 | 5.1 | 75 | 70.5 | 25.7 | 35 | 126.9 | 46.2 | 95 | 183.2 | 66.7 | 55 | 239.6 | 87.2 |
| 16 | 15.0 | 5.5 | 76 | 71.4 | 26.0 | 36 | 127.8 | 46.5 | 96 | 184.2 | 67.0 | 56 | 240.6 | 87.6 |
| 17 | 16.0 | 5.8 | 77 | 72.4 | 26.3 | 37 | 128.7 | 46.9 | 97 | 185.1 | 67.4 | 57 | 241.5 | 87.9 |
| 18 | 16.9 | 6.2 | 78 | 73.3 | 26.7 | 38 | 129.7 | 47.2 | 98 | 186.1 | 67.7 | 58 | 242.4 | 88.2 |
| 19 | 17.9 | 6.5 | 79 | 74.2 | 27.0 | 39 | 130.6 | 47.5 | 99 | 187.0 | 68.1 | 59 | 243.4 | 88.6 |
| 20 | 18.8 | 6.8 | 80 | 75.2 | 27.4 | 40 | 131.6 | 47.9 | 200 | 187.9 | 68.4 | 60 | 244.3 | 88.9 |
| 21 | 19.7 | 7.2 | 81 | 76.1 | 27.7 | 141 | 132.5 | 48.2 | 201 | 188.9 | 68.7 | 261 | 245.3 | 89.3 |
| 22 | 20.7 | 7.5 | 82 | 77.1 | 28.0 | 42 | 133.4 | 48.6 | 02 | 189.8 | 69.1 | 62 | 246.2 | 89.6 |
| 23 | 21.6 | 7.9 | 83 | 78.0 | 28.4 | 43 | 134.4 | 48.9 | 03 | 190.8 | 69.4 | 63 | 247.1 | 90.0 |
| 24 | 22.6 | 8.2 | 84 | 78.9 | 28.7 | 44 | 135.3 | 49.3 | 04 | 191.7 | 69.8 | 64 | 248.1 | 90.3 |
| 25 | 23.5 | 8.6 | 85 | 79.9 | 29.1 | 45 | 136.3 | 49.6 | 05 | 192.6 | 70.1 | 65 | 249.0 | 90.6 |
| 26 | 24.4 | 8.9 | 86 | 80.8 | 29.4 | 46 | 137.2 | 49.9 | 06 | 193.6 | 70.5 | 66 | 250.0 | 91.0 |
| 27 | 25.4 | 9.2 | 87 | 81.8 | 29.8 | 47 | 138.1 | 50.3 | 07 | 194.5 | 70.8 | 67 | 250.9 | 91.3 |
| 28 | 26.3 | 9.6 | 88 | 82.7 | 30.1 | 48 | 139.1 | 50.6 | 08 | 195.5 | 71.1 | 68 | 251.8 | 91.7 |
| 29 | 27.3 | 9.9 | 89 | 83.6 | 30.4 | 49 | 140.0 | 51.0 | 09 | 196.4 | 71.5 | 69 | 252.8 | 92.0 |
| 30 | 28.2 | 10.3 | 90 | 84.6 | 30.8 | 50 | 140.0 | 51.3 | 10 | 197.3 | 71.8 | 70 | 253.7 | 92.3 |
| 31 | 29.1 | 10.6 | 91 | 85.5 | 31.1 | 151 | 141.9 | 51.6 | 211 | 198.3 | 72.2 | 271 | 254.7 | 92.7 |
| 32 | 30.1 | 10.9 | 92 | 86.5 | 31.5 | 52 | 142.8 | 52.0 | 12 | 199.2 | 72.5 | 72 | 255.6 | 93.0 |
| 33 | 31.0 | 11.3 | 93 | 87.4 | 31.8 | 53 | 143.8 | 52.3 | 13 | 200.2 | 72.9 | 73 | 256.5 | 93.4 |
| 34 | 31.9 | 11.6 | 94 | 88.3 | 32.1 | 54 | 144.7 | 52.7 | 14 | 201.1 | 73.2 | 74 | 257.5 | 93.7 |
| 35 | 32.9 | 12.0 | 95 | 89.3 | 32.5 | 55 | 145.7 | 53.0 | 15 | 202.0 | 73.5 | 75 | 258.4 | 94.1 |
| 36 | 33.8 | 12.3 | 96 | 90.2 | 32.8 | 56 | 146.6 | 53.4 | 16 | 203.0 | 73.9 | 76 | 259.4 | 94.4 |
| 37 | 34.8 | 12.7 | 97 | 91.2 | 33.2 | 57 | 147.5 | 53.7 | 17 | 203.9 | 74.2 | 77 | 260.3 | 94.7 |
| 38 | 35.7 | 13.0 | 98 | 92.1 | 33.5 | 58 | 148.5 | 54.0 | 18 | 204.9 | 74.6 | 78 | 261.2 | 95.1 |
| 39 | 36.6 | 13.3 | 99 | 93.0 | 33.9 | 59 | 149.4 | 54.4 | 19 | 205.8 | 74.9 | 79 | 262.2 | 95.4 |
| 40 | 37.6 | 13.7 | 100 | 94.0 | 34.2 | 60 | 150.4 | 54.7 | 20 | 206.7 | 75.2 | 80 | 263.1 | 95.8 |
| 41 | 38.5 | 14.0 | 101 | 94.9 | 34.5 | 161 | 151.3 | 55.1 | 221 | 207.7 | 75.6 | 281 | 264.1 | 96.1 |
| 42 | 39.5 | 14.4 | 02 | 95.8 | 34.9 | 62 | 152.2 | 55.4 | 22 | 208.6 | 75.9 | 82 | 265.0 | 96.4 |
| 43 | 40.4 | 14.7 | 03 | 96.8 | 35.2 | 63 | 153.2 | 55.7 | 23 | 209.6 | 76.3 | 83 | 265.9 | 96.8 |
| 44 | 41.3 | 15.0 | 04 | 97.7 | 35.6 | 64 | 154.1 | 56.1 | 24 | 210.5 | 76.6 | 84 | 266.9 | 97.1 |
| 45 | 42.3 | 15.4 | 05 | 98.7 | 35.9 | 65 | 155.0 | 56.4 | 25 | 211.4 | 77.0 | 85 | 267.8 | 97.5 |
| 46 | 43.2 | 15.7 | 06 | 99.6 | 36.3 | 66 | 156.0 | 56.8 | 26 | 212.4 | 77.3 | 86 | 268.8 | 97.8 |
| 47 | 44.2 | 16.1 | 07 | 100.5 | 36.6 | 67 | 156.9 | 57.1 | 27 | 213.3 | 77.6 | 87 | 269.7 | 98.2 |
| 48 | 45.1 | 16.4 | 08 | 101.5 | 36.9 | 68 | 157.9 | 57.5 | 28 | 214.2 | 78.0 | 88 | 270.6 | 98.5 |
| 49 | 46.0 | 16.8 | 09 | 102.4 | 37.3 | 69 | 158.8 | 57.8 | 29 | 215.2 | 78.3 | 89 | 271.6 | 98.8 |
| 50 | 47.0 | 17.1 | 10 | 103.4 | 37.6 | 70 | 159.7 | 58.1 | 30 | 216.1 | 78.7 | 90 | 272.5 | 99.2 |
| 51 | 47.9 | 17.4 | 111 | 104.3 | 38.0 | 171 | 160.7 | 58.5 | 231 | 217.1 | 79.0 | 291 | 273.5 | 99.5 |
| 52 | 48.9 | 17.8 | 12 | 105.2 | 38.3 | 72 | 161.6 | 58.8 | 32 | 218.0 | 79.3 | 92 | 274.4 | 99.9 |
| 53 | 49.8 | 18.1 | 13 | 106.2 | 38.6 | 73 | 162.6 | 59.2 | 33 | 218.9 | 79.7 | 93 | 275.3 | 100.3 |
| 54 | 50.7 | 18.5 | 14 | 107.1 | 39.0 | 74 | 163.5 | 59.5 | 34 | 219.9 | 80.0 | 94 | 276.3 | 100.6 |
| 55 | 51.7 | 18.8 | 15 | 108.1 | 39.3 | 75 | 164.4 | 59.9 | 35 | 220.8 | 80.4 | 95 | 277.2 | 100.9 |
| 56 | 52.6 | 19.2 | 16 | 109.0 | 39.7 | 76 | 165.4 | 60.2 | 36 | 221.8 | 80.7 | 96 | 278.1 | 101.2 |
| 57 | 53.6 | 19.5 | 17 | 109.9 | 40.0 | 77 | 166.3 | 60.5 | 37 | 222.7 | 81.1 | 97 | 279.1 | 101.6 |
| 58 | 54.5 | 19.8 | 18 | 110.9 | 40.4 | 78 | 167.3 | 60.9 | 38 | 223.6 | 81.4 | 98 | 280.0 | 101.9 |
| 59 | 55.4 | 20.2 | 19 | 111.8 | 40.7 | 79 | 168.2 | 61.2 | 39 | 224.6 | 81.7 | 99 | 281.0 | 102.3 |
| 60 | 56.4 | 20.5 | 20 | 112.8 | 41.0 | 80 | 169.1 | 61.6 | 40 | 225.5 | 82.1 | 100 | 281.9 | 102.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 70 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 21°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|-------|
| 1 | 0.9 | 0.4 | 61 | 56.9 | 21.9 | 121 | 113.0 | 43.4 | 181 | 169.0 | 64.9 | 241 | 225.0 | 86.4 |
| 2 | 1.9 | 0.7 | 62 | 57.9 | 22.2 | 22 | 113.9 | 43.7 | 82 | 169.9 | 65.2 | 42 | 225.9 | 86.7 |
| 3 | 2.8 | 1.1 | 63 | 58.8 | 22.6 | 23 | 114.8 | 44.1 | 83 | 170.8 | 65.6 | 43 | 226.9 | 87.1 |
| 4 | 3.7 | 1.4 | 64 | 59.7 | 22.9 | 24 | 115.8 | 44.4 | 84 | 171.8 | 65.9 | 44 | 227.8 | 87.4 |
| 5 | 4.7 | 1.8 | 65 | 60.7 | 23.3 | 25 | 116.7 | 44.8 | 85 | 172.7 | 66.3 | 45 | 228.7 | 87.8 |
| 6 | 5.6 | 2.2 | 66 | 61.6 | 23.7 | 26 | 117.6 | 45.2 | 86 | 173.6 | 66.7 | 46 | 229.7 | 88.2 |
| 7 | 6.5 | 2.5 | 67 | 62.5 | 24.0 | 27 | 118.6 | 45.5 | 87 | 174.6 | 67.0 | 47 | 230.6 | 88.5 |
| 8 | 7.5 | 2.9 | 68 | 63.5 | 24.4 | 28 | 119.5 | 45.9 | 88 | 175.5 | 67.4 | 48 | 231.5 | 88.9 |
| 9 | 8.4 | 3.2 | 69 | 64.4 | 24.7 | 29 | 120.4 | 46.2 | 89 | 176.4 | 67.7 | 49 | 232.5 | 89.2 |
| 10 | 9.3 | 3.6 | 70 | 65.4 | 25.1 | 30 | 121.4 | 46.6 | 90 | 177.4 | 68.1 | 50 | 233.4 | 89.6 |
| 11 | 10.3 | 3.9 | 71 | 66.3 | 25.4 | 31 | 122.3 | 46.9 | 91 | 178.3 | 68.4 | 51 | 234.3 | 90.0 |
| 12 | 11.2 | 4.3 | 72 | 67.2 | 25.8 | 32 | 123.2 | 47.3 | 92 | 179.2 | 68.8 | 52 | 235.3 | 90.3 |
| 13 | 12.1 | 4.7 | 73 | 68.2 | 26.2 | 33 | 124.2 | 47.7 | 93 | 180.2 | 69.2 | 53 | 236.2 | 90.7 |
| 14 | 13.1 | 5.0 | 74 | 69.1 | 26.5 | 34 | 125.1 | 48.0 | 94 | 181.1 | 69.5 | 54 | 237.1 | 91.0 |
| 15 | 14.0 | 5.4 | 75 | 70.0 | 26.9 | 35 | 126.0 | 48.4 | 95 | 182.0 | 69.9 | 55 | 238.1 | 91.4 |
| 16 | 14.9 | 5.7 | 76 | 71.0 | 27.2 | 36 | 127.0 | 48.7 | 96 | 183.0 | 70.2 | 56 | 239.0 | 91.7 |
| 17 | 15.9 | 6.1 | 77 | 71.9 | 27.6 | 37 | 127.9 | 49.1 | 97 | 183.9 | 70.6 | 57 | 239.9 | 92.1 |
| 18 | 16.8 | 6.5 | 78 | 72.8 | 28.0 | 38 | 128.8 | 49.5 | 98 | 184.8 | 71.0 | 58 | 240.9 | 92.5 |
| 19 | 17.7 | 6.8 | 79 | 73.8 | 28.3 | 39 | 129.8 | 49.8 | 99 | 185.8 | 71.3 | 59 | 241.8 | 92.8 |
| 20 | 18.7 | 7.2 | 80 | 74.7 | 28.7 | 40 | 130.7 | 50.2 | 200 | 186.7 | 71.7 | 60 | 242.7 | 93.2 |
| 21 | 19.6 | 7.5 | 81 | 75.6 | 29.0 | 41 | 131.6 | 50.5 | 201 | 187.6 | 72.0 | 61 | 243.7 | 93.5 |
| 22 | 20.5 | 7.9 | 82 | 76.6 | 29.4 | 42 | 132.6 | 50.9 | 02 | 188.6 | 72.4 | 62 | 244.6 | 93.9 |
| 23 | 21.5 | 8.2 | 83 | 77.5 | 29.7 | 43 | 133.5 | 51.2 | 03 | 189.5 | 72.7 | 63 | 245.5 | 94.3 |
| 24 | 22.4 | 8.6 | 84 | 78.4 | 30.1 | 44 | 134.4 | 51.6 | 04 | 190.5 | 73.1 | 64 | 246.5 | 94.6 |
| 25 | 23.3 | 9.0 | 85 | 79.4 | 30.5 | 45 | 135.4 | 52.0 | 05 | 191.4 | 73.5 | 65 | 247.4 | 95.0 |
| 26 | 24.3 | 9.3 | 86 | 80.3 | 30.8 | 46 | 136.3 | 52.3 | 06 | 192.3 | 73.8 | 66 | 248.3 | 95.3 |
| 27 | 25.2 | 9.7 | 87 | 81.2 | 31.2 | 47 | 137.2 | 52.7 | 07 | 193.3 | 74.2 | 67 | 249.3 | 95.7 |
| 28 | 26.1 | 10.0 | 88 | 82.2 | 31.5 | 48 | 138.2 | 53.0 | 08 | 194.2 | 74.5 | 68 | 250.2 | 96.0 |
| 29 | 27.1 | 10.4 | 89 | 83.1 | 31.9 | 49 | 139.1 | 53.4 | 09 | 195.1 | 74.9 | 69 | 251.1 | 96.4 |
| 30 | 28.0 | 10.8 | 90 | 84.0 | 32.3 | 50 | 140.0 | 53.8 | 10 | 196.1 | 75.3 | 70 | 252.1 | 96.8 |
| 31 | 28.9 | 11.1 | 91 | 85.0 | 32.6 | 51 | 141.0 | 54.1 | 211 | 197.0 | 75.6 | 271 | 253.0 | 97.1 |
| 32 | 29.9 | 11.5 | 92 | 85.9 | 33.0 | 52 | 141.9 | 54.5 | 12 | 197.9 | 76.0 | 72 | 253.9 | 97.5 |
| 33 | 30.8 | 11.8 | 93 | 86.8 | 33.3 | 53 | 142.8 | 54.8 | 13 | 198.9 | 76.3 | 73 | 254.9 | 97.8 |
| 34 | 31.7 | 12.2 | 94 | 87.8 | 33.7 | 54 | 143.8 | 55.2 | 14 | 199.8 | 76.7 | 74 | 255.8 | 98.2 |
| 35 | 32.7 | 12.5 | 95 | 88.7 | 34.0 | 55 | 144.7 | 55.5 | 15 | 200.7 | 77.0 | 75 | 256.7 | 98.6 |
| 36 | 33.6 | 12.9 | 96 | 89.6 | 34.4 | 56 | 145.6 | 55.9 | 16 | 201.7 | 77.4 | 76 | 257.7 | 98.9 |
| 37 | 34.5 | 13.3 | 97 | 90.6 | 34.8 | 57 | 146.6 | 56.3 | 17 | 202.6 | 77.8 | 77 | 258.6 | 99.3 |
| 38 | 35.5 | 13.6 | 98 | 91.5 | 35.1 | 58 | 147.5 | 56.6 | 18 | 203.5 | 78.1 | 78 | 259.5 | 99.6 |
| 39 | 36.4 | 14.0 | 99 | 92.4 | 35.5 | 59 | 148.4 | 57.0 | 19 | 204.5 | 78.5 | 79 | 260.5 | 100.0 |
| 40 | 37.3 | 14.3 | 100 | 93.4 | 35.8 | 60 | 149.4 | 57.3 | 20 | 205.4 | 78.8 | 80 | 261.4 | 100.3 |
| 41 | 38.3 | 14.7 | 101 | 94.3 | 36.2 | 61 | 150.3 | 57.7 | 221 | 206.3 | 79.2 | 281 | 262.3 | 100.7 |
| 42 | 39.2 | 15.1 | 02 | 95.2 | 36.6 | 62 | 151.2 | 58.1 | 22 | 207.3 | 79.6 | 82 | 263.3 | 101.1 |
| 43 | 40.1 | 15.4 | 03 | 96.2 | 36.9 | 63 | 152.2 | 58.4 | 23 | 208.2 | 79.9 | 83 | 264.2 | 101.4 |
| 44 | 41.1 | 15.8 | 04 | 97.1 | 37.3 | 64 | 153.1 | 58.8 | 24 | 209.1 | 80.3 | 84 | 265.1 | 101.8 |
| 45 | 42.0 | 16.1 | 05 | 98.0 | 37.6 | 65 | 154.0 | 59.1 | 25 | 210.1 | 80.6 | 85 | 266.1 | 102.1 |
| 46 | 42.9 | 16.5 | 06 | 99.0 | 38.0 | 66 | 155.0 | 59.5 | 26 | 211.0 | 81.0 | 86 | 267.0 | 102.5 |
| 47 | 43.9 | 16.8 | 07 | 99.9 | 38.3 | 67 | 155.9 | 59.8 | 27 | 211.9 | 81.3 | 87 | 267.9 | 102.9 |
| 48 | 44.8 | 17.2 | 08 | 100.8 | 38.7 | 68 | 156.8 | 60.2 | 28 | 212.9 | 81.7 | 88 | 268.9 | 103.2 |
| 49 | 45.7 | 17.6 | 09 | 101.8 | 39.1 | 69 | 157.8 | 60.6 | 29 | 213.8 | 82.1 | 89 | 269.8 | 103.6 |
| 50 | 46.7 | 17.9 | 10 | 102.7 | 39.4 | 70 | 158.7 | 60.9 | 30 | 214.7 | 82.4 | 90 | 270.7 | 103.9 |
| 51 | 47.6 | 18.3 | 11 | 103.6 | 39.8 | 71 | 159.6 | 61.3 | 231 | 215.7 | 82.8 | 291 | 271.7 | 104.3 |
| 52 | 48.5 | 18.6 | 12 | 104.6 | 40.1 | 72 | 160.6 | 61.6 | 32 | 216.6 | 83.1 | 92 | 272.6 | 104.6 |
| 53 | 49.5 | 19.0 | 13 | 105.5 | 40.5 | 73 | 161.5 | 62.0 | 33 | 217.5 | 83.5 | 93 | 273.5 | 105.0 |
| 54 | 50.4 | 19.4 | 14 | 106.4 | 40.9 | 74 | 162.4 | 62.4 | 34 | 218.5 | 83.9 | 94 | 274.5 | 105.4 |
| 55 | 51.3 | 19.7 | 15 | 107.4 | 41.2 | 75 | 163.4 | 62.7 | 35 | 219.4 | 84.2 | 95 | 275.4 | 105.7 |
| 56 | 52.3 | 20.1 | 16 | 108.3 | 41.6 | 76 | 164.3 | 63.1 | 36 | 220.3 | 84.6 | 96 | 276.3 | 106.1 |
| 57 | 53.2 | 20.4 | 17 | 109.2 | 41.9 | 77 | 165.2 | 63.4 | 37 | 221.3 | 84.9 | 97 | 277.3 | 106.4 |
| 58 | 54.1 | 20.8 | 18 | 110.2 | 42.3 | 78 | 166.2 | 63.8 | 38 | 222.2 | 85.3 | 98 | 278.2 | 106.8 |
| 59 | 55.1 | 21.1 | 19 | 111.1 | 42.6 | 79 | 167.1 | 64.1 | 39 | 223.1 | 85.6 | 99 | 279.1 | 107.2 |
| 60 | 56.0 | 21.5 | 20 | 112.0 | 43.0 | 80 | 168.0 | 64.5 | 40 | 224.1 | 86.0 | 300 | 280.1 | 107.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 69 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 22°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|-------|
| 1 | 0.9 | 0.4 | 61 | 56.6 | 22.9 | 121 | 112.2 | 45.3 | 181 | 167.8 | 67.8 | 241 | 223.5 | 90.3 |
| 2 | 1.9 | 0.7 | 62 | 57.5 | 23.2 | 22 | 113.1 | 45.7 | 82 | 168.7 | 68.2 | 42 | 224.4 | 90.7 |
| 3 | 2.8 | 1.1 | 63 | 58.4 | 23.6 | 23 | 114.0 | 46.1 | 83 | 169.7 | 68.6 | 43 | 225.3 | 91.0 |
| 4 | 3.7 | 1.5 | 64 | 59.3 | 24.0 | 24 | 115.0 | 46.5 | 84 | 170.6 | 68.9 | 44 | 226.2 | 91.4 |
| 5 | 4.6 | 1.9 | 65 | 60.3 | 24.3 | 25 | 115.9 | 46.8 | 85 | 171.5 | 69.3 | 45 | 227.2 | 91.8 |
| 6 | 5.6 | 2.2 | 66 | 61.2 | 24.7 | 26 | 116.8 | 47.2 | 86 | 172.5 | 69.7 | 46 | 228.1 | 92.2 |
| 7 | 6.5 | 2.6 | 67 | 62.1 | 25.1 | 27 | 117.8 | 47.6 | 87 | 173.4 | 70.1 | 47 | 229.0 | 92.5 |
| 8 | 7.4 | 3.0 | 68 | 63.0 | 25.5 | 28 | 118.7 | 47.9 | 88 | 174.3 | 70.4 | 48 | 229.9 | 92.9 |
| 9 | 8.3 | 3.4 | 69 | 64.0 | 25.8 | 29 | 119.6 | 48.3 | 89 | 175.2 | 70.8 | 49 | 230.9 | 93.3 |
| 10 | 9.3 | 3.7 | 70 | 64.9 | 26.2 | 30 | 120.5 | 48.7 | 90 | 176.2 | 71.2 | 50 | 231.8 | 93.7 |
| 11 | 10.2 | 4.1 | 71 | 65.8 | 26.6 | 131 | 121.5 | 49.1 | 191 | 177.1 | 71.5 | 251 | 232.7 | 94.0 |
| 12 | 11.1 | 4.5 | 72 | 66.8 | 27.0 | 32 | 122.4 | 49.4 | 92 | 178.0 | 71.9 | 52 | 233.7 | 94.4 |
| 13 | 12.1 | 4.9 | 73 | 67.7 | 27.3 | 33 | 123.3 | 49.8 | 93 | 178.9 | 72.3 | 53 | 234.6 | 94.8 |
| 14 | 13.0 | 5.2 | 74 | 68.6 | 27.7 | 34 | 124.2 | 50.2 | 94 | 179.9 | 72.7 | 54 | 235.5 | 95.2 |
| 15 | 13.9 | 5.6 | 75 | 69.5 | 28.1 | 35 | 125.2 | 50.6 | 95 | 180.8 | 73.0 | 55 | 236.4 | 95.5 |
| 16 | 14.8 | 6.0 | 76 | 70.5 | 28.5 | 36 | 126.1 | 50.9 | 96 | 181.7 | 73.4 | 56 | 237.4 | 95.9 |
| 17 | 15.8 | 6.4 | 77 | 71.4 | 28.8 | 37 | 127.0 | 51.3 | 97 | 182.7 | 73.8 | 57 | 238.3 | 96.3 |
| 18 | 16.7 | 6.7 | 78 | 72.3 | 29.2 | 38 | 128.0 | 51.7 | 98 | 183.6 | 74.2 | 58 | 239.2 | 96.6 |
| 19 | 17.6 | 7.1 | 79 | 73.2 | 29.6 | 39 | 128.9 | 52.1 | 99 | 184.5 | 74.5 | 59 | 240.1 | 97.0 |
| 20 | 18.5 | 7.5 | 80 | 74.2 | 30.0 | 40 | 129.8 | 52.4 | 200 | 185.4 | 74.9 | 60 | 241.1 | 97.4 |
| 21 | 19.5 | 7.9 | 81 | 75.1 | 30.3 | 141 | 130.7 | 52.8 | 201 | 186.4 | 75.3 | 261 | 242.0 | 97.8 |
| 22 | 20.4 | 8.2 | 82 | 76.0 | 30.7 | 42 | 131.7 | 53.2 | 02 | 187.3 | 75.7 | 62 | 242.9 | 98.1 |
| 23 | 21.3 | 8.6 | 83 | 77.0 | 31.1 | 43 | 132.6 | 53.6 | 03 | 188.2 | 76.0 | 63 | 243.8 | 98.5 |
| 24 | 22.3 | 9.0 | 84 | 77.9 | 31.5 | 44 | 133.5 | 53.9 | 04 | 189.1 | 76.4 | 64 | 244.8 | 98.9 |
| 25 | 23.2 | 9.4 | 85 | 78.8 | 31.8 | 45 | 134.4 | 54.3 | 05 | 190.1 | 76.8 | 65 | 245.7 | 99.3 |
| 26 | 24.1 | 9.7 | 86 | 79.7 | 32.2 | 46 | 135.4 | 54.7 | 06 | 191.0 | 77.2 | 66 | 246.6 | 99.6 |
| 27 | 25.0 | 10.1 | 87 | 80.7 | 32.6 | 47 | 136.3 | 55.1 | 07 | 191.9 | 77.5 | 67 | 247.6 | 100.0 |
| 28 | 26.0 | 10.5 | 88 | 81.6 | 33.0 | 48 | 137.2 | 55.4 | 08 | 192.9 | 77.9 | 68 | 248.5 | 100.4 |
| 29 | 26.9 | 10.9 | 89 | 82.5 | 33.3 | 49 | 138.2 | 55.8 | 09 | 193.8 | 78.3 | 69 | 249.4 | 100.8 |
| 30 | 27.8 | 11.2 | 90 | 83.4 | 33.7 | 50 | 139.1 | 56.2 | 10 | 194.7 | 78.7 | 70 | 250.3 | 101.1 |
| 31 | 28.7 | 11.6 | 91 | 84.4 | 34.1 | 151 | 140.0 | 56.6 | 211 | 195.6 | 79.0 | 271 | 251.3 | 101.5 |
| 32 | 29.7 | 12.0 | 92 | 85.3 | 34.5 | 52 | 140.9 | 56.9 | 12 | 196.6 | 79.4 | 72 | 252.2 | 101.9 |
| 33 | 30.6 | 12.4 | 93 | 86.2 | 34.8 | 53 | 141.9 | 57.3 | 13 | 197.5 | 79.8 | 73 | 253.1 | 102.3 |
| 34 | 31.5 | 12.7 | 94 | 87.2 | 35.2 | 54 | 142.8 | 57.7 | 14 | 198.4 | 80.2 | 74 | 254.0 | 102.6 |
| 35 | 32.5 | 13.1 | 95 | 88.1 | 35.6 | 55 | 143.7 | 58.1 | 15 | 199.3 | 80.5 | 75 | 255.0 | 103.0 |
| 36 | 33.4 | 13.5 | 96 | 89.0 | 36.0 | 56 | 144.6 | 58.4 | 16 | 200.3 | 80.9 | 76 | 255.9 | 103.4 |
| 37 | 34.3 | 13.9 | 97 | 89.9 | 36.3 | 57 | 145.6 | 58.8 | 17 | 201.2 | 81.3 | 77 | 256.8 | 103.8 |
| 38 | 35.2 | 14.2 | 98 | 90.9 | 36.7 | 58 | 146.5 | 59.2 | 18 | 202.1 | 81.7 | 78 | 257.8 | 104.1 |
| 39 | 36.2 | 14.6 | 99 | 91.8 | 37.1 | 59 | 147.4 | 59.6 | 19 | 203.1 | 82.0 | 79 | 258.7 | 104.5 |
| 40 | 37.1 | 15.0 | 100 | 92.7 | 37.5 | 60 | 148.3 | 59.9 | 20 | 204.0 | 82.4 | 80 | 259.6 | 104.9 |
| 41 | 38.0 | 15.4 | 101 | 93.6 | 37.8 | 161 | 149.3 | 60.3 | 221 | 204.9 | 82.8 | 281 | 260.5 | 105.3 |
| 42 | 38.9 | 15.7 | 02 | 94.6 | 38.2 | 62 | 150.2 | 60.7 | 22 | 205.8 | 83.2 | 82 | 261.5 | 105.6 |
| 43 | 39.9 | 16.1 | 03 | 95.5 | 38.6 | 63 | 151.1 | 61.1 | 23 | 206.8 | 83.5 | 83 | 262.4 | 106.0 |
| 44 | 40.8 | 16.5 | 04 | 96.4 | 39.0 | 64 | 152.1 | 61.4 | 24 | 207.7 | 83.9 | 84 | 263.3 | 106.4 |
| 45 | 41.7 | 16.9 | 05 | 97.4 | 39.3 | 65 | 153.0 | 61.8 | 25 | 208.6 | 84.3 | 85 | 264.2 | 106.8 |
| 46 | 42.7 | 17.2 | 06 | 98.3 | 39.7 | 66 | 153.9 | 62.2 | 26 | 209.5 | 84.7 | 86 | 265.2 | 107.1 |
| 47 | 43.6 | 17.6 | 07 | 99.2 | 40.1 | 67 | 154.8 | 62.6 | 27 | 210.5 | 85.0 | 87 | 266.1 | 107.5 |
| 48 | 44.5 | 18.0 | 08 | 100.1 | 40.5 | 68 | 155.8 | 62.9 | 28 | 211.4 | 85.4 | 88 | 267.0 | 107.9 |
| 49 | 45.4 | 18.4 | 09 | 101.1 | 40.8 | 69 | 156.7 | 63.3 | 29 | 212.3 | 85.8 | 89 | 268.0 | 108.3 |
| 50 | 46.4 | 18.7 | 10 | 102.0 | 41.2 | 70 | 157.6 | 63.7 | 30 | 213.3 | 86.2 | 90 | 268.9 | 108.6 |
| 51 | 47.3 | 19.1 | 111 | 102.9 | 41.6 | 171 | 158.5 | 64.1 | 231 | 214.2 | 86.5 | 291 | 269.8 | 109.0 |
| 52 | 48.2 | 19.5 | 12 | 103.8 | 42.0 | 72 | 159.5 | 64.4 | 32 | 215.1 | 86.9 | 92 | 270.7 | 109.4 |
| 53 | 49.1 | 19.9 | 13 | 104.8 | 42.3 | 73 | 160.4 | 64.8 | 33 | 216.0 | 87.3 | 93 | 271.7 | 109.8 |
| 54 | 50.1 | 20.2 | 14 | 105.7 | 42.7 | 74 | 161.3 | 65.2 | 34 | 217.0 | 87.7 | 94 | 272.6 | 110.1 |
| 55 | 51.0 | 20.6 | 15 | 106.6 | 43.1 | 75 | 162.3 | 65.6 | 35 | 217.9 | 88.0 | 95 | 273.5 | 110.5 |
| 56 | 51.9 | 21.0 | 16 | 107.6 | 43.5 | 76 | 163.2 | 65.9 | 36 | 218.8 | 88.4 | 96 | 274.4 | 110.9 |
| 57 | 52.8 | 21.4 | 17 | 108.5 | 43.8 | 77 | 164.1 | 66.3 | 37 | 219.7 | 88.8 | 97 | 275.4 | 111.3 |
| 58 | 53.8 | 21.7 | 18 | 109.4 | 44.2 | 78 | 165.0 | 66.7 | 38 | 220.7 | 89.2 | 98 | 276.3 | 111.6 |
| 59 | 54.7 | 22.1 | 19 | 110.3 | 44.6 | 79 | 166.0 | 67.1 | 39 | 221.6 | 89.5 | 99 | 277.2 | 112.0 |
| 60 | 55.6 | 22.5 | 20 | 111.3 | 45.0 | 80 | 166.9 | 67.4 | 40 | 222.5 | 89.9 | 300 | 278.2 | 112.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 68 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 23°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|-------|
| 1 | 0.0 | 0.4 | 61 | 56.2 | 23.8 | 121 | 111.4 | 47.3 | 181 | 166.6 | 70.7 | 241 | 221.8 | 94.2 |
| 2 | 1.8 | 0.8 | 62 | 57.1 | 24.2 | 22 | 112.3 | 47.7 | 82 | 167.5 | 71.1 | 42 | 222.8 | 94.6 |
| 3 | 2.8 | 1.2 | 63 | 58.0 | 24.6 | 23 | 113.2 | 48.1 | 83 | 168.5 | 71.5 | 43 | 223.7 | 94.9 |
| 4 | 3.7 | 1.6 | 64 | 58.9 | 25.0 | 24 | 114.1 | 48.5 | 84 | 169.4 | 71.9 | 44 | 224.6 | 95.3 |
| 5 | 4.6 | 2.0 | 65 | 59.8 | 25.4 | 25 | 115.1 | 48.8 | 85 | 170.3 | 72.3 | 45 | 225.5 | 95.7 |
| 6 | 5.5 | 2.3 | 66 | 60.8 | 25.8 | 26 | 116.0 | 49.2 | 86 | 171.2 | 72.7 | 46 | 226.4 | 96.1 |
| 7 | 6.4 | 2.7 | 67 | 61.7 | 26.2 | 27 | 116.9 | 49.6 | 87 | 172.1 | 73.1 | 47 | 227.4 | 96.5 |
| 8 | 7.4 | 3.1 | 68 | 62.6 | 26.6 | 28 | 117.8 | 50.0 | 88 | 173.1 | 73.5 | 48 | 228.3 | 96.9 |
| 9 | 8.3 | 3.5 | 69 | 63.5 | 27.0 | 29 | 118.7 | 50.4 | 89 | 174.0 | 73.8 | 49 | 229.2 | 97.3 |
| 10 | 9.2 | 3.9 | 70 | 64.4 | 27.4 | 30 | 119.7 | 50.8 | 90 | 174.9 | 74.2 | 50 | 230.1 | 97.7 |
| 11 | 10.1 | 4.3 | 71 | 65.4 | 27.7 | 31 | 120.6 | 51.2 | 191 | 175.8 | 74.6 | 251 | 231.0 | 98.1 |
| 12 | 11.0 | 4.7 | 72 | 66.3 | 28.1 | 32 | 121.5 | 51.6 | 92 | 176.7 | 75.0 | 52 | 232.0 | 98.5 |
| 13 | 12.0 | 5.1 | 73 | 67.2 | 28.5 | 33 | 122.4 | 52.0 | 93 | 177.7 | 75.4 | 53 | 232.9 | 98.9 |
| 14 | 12.9 | 5.5 | 74 | 68.1 | 28.9 | 34 | 123.3 | 52.4 | 94 | 178.6 | 75.8 | 54 | 233.8 | 99.2 |
| 15 | 13.8 | 5.9 | 75 | 69.0 | 29.3 | 35 | 124.2 | 52.7 | 95 | 179.5 | 76.2 | 55 | 234.7 | 99.6 |
| 16 | 14.7 | 6.3 | 76 | 70.0 | 29.7 | 36 | 125.2 | 53.1 | 96 | 180.4 | 76.6 | 56 | 235.6 | 100.0 |
| 17 | 15.6 | 6.6 | 77 | 70.9 | 30.1 | 37 | 126.1 | 53.5 | 97 | 181.3 | 77.0 | 57 | 236.6 | 100.4 |
| 18 | 16.6 | 7.0 | 78 | 71.8 | 30.5 | 38 | 127.0 | 53.9 | 98 | 182.3 | 77.4 | 58 | 237.5 | 100.8 |
| 19 | 17.5 | 7.4 | 79 | 72.7 | 30.9 | 39 | 128.0 | 54.3 | 99 | 183.2 | 77.8 | 59 | 238.4 | 101.2 |
| 20 | 18.4 | 7.8 | 80 | 73.6 | 31.3 | 40 | 128.9 | 54.7 | 200 | 184.1 | 78.1 | 60 | 239.3 | 101.6 |
| 21 | 19.3 | 8.2 | 81 | 74.6 | 31.6 | 41 | 129.8 | 55.1 | 201 | 185.0 | 78.5 | 261 | 240.3 | 102.0 |
| 22 | 20.3 | 8.6 | 82 | 75.5 | 32.0 | 42 | 130.7 | 55.5 | 02 | 185.9 | 78.9 | 62 | 241.2 | 102.4 |
| 23 | 21.2 | 9.0 | 83 | 76.4 | 32.4 | 43 | 131.6 | 55.9 | 03 | 186.9 | 79.3 | 63 | 242.1 | 102.8 |
| 24 | 22.1 | 9.4 | 84 | 77.3 | 32.8 | 44 | 132.6 | 56.3 | 04 | 187.8 | 79.7 | 64 | 243.0 | 103.2 |
| 25 | 23.0 | 9.8 | 85 | 78.2 | 33.2 | 45 | 133.5 | 56.7 | 05 | 188.7 | 80.1 | 65 | 243.9 | 103.5 |
| 26 | 23.9 | 10.2 | 86 | 79.2 | 33.6 | 46 | 134.4 | 57.0 | 06 | 189.6 | 80.5 | 66 | 244.9 | 103.9 |
| 27 | 24.9 | 10.5 | 87 | 80.1 | 34.0 | 47 | 135.3 | 57.4 | 07 | 190.5 | 80.9 | 67 | 245.8 | 104.3 |
| 28 | 25.8 | 10.9 | 88 | 81.0 | 34.4 | 48 | 136.2 | 57.8 | 08 | 191.5 | 81.3 | 68 | 246.7 | 104.7 |
| 29 | 26.7 | 11.3 | 89 | 81.9 | 34.8 | 49 | 137.2 | 58.2 | 09 | 192.4 | 81.7 | 69 | 247.6 | 105.1 |
| 30 | 27.6 | 11.7 | 90 | 82.8 | 35.2 | 50 | 138.1 | 58.6 | 10 | 193.3 | 82.1 | 70 | 248.5 | 105.5 |
| 31 | 28.5 | 12.1 | 91 | 83.8 | 35.6 | 151 | 139.0 | 59.0 | 211 | 194.2 | 82.4 | 271 | 249.5 | 105.9 |
| 32 | 29.5 | 12.5 | 92 | 84.7 | 35.9 | 52 | 139.9 | 59.4 | 12 | 195.1 | 82.8 | 72 | 250.4 | 106.3 |
| 33 | 30.4 | 12.9 | 93 | 85.6 | 36.3 | 53 | 140.8 | 59.8 | 13 | 196.1 | 83.2 | 73 | 251.3 | 106.7 |
| 34 | 31.3 | 13.3 | 94 | 86.5 | 36.7 | 54 | 141.7 | 60.2 | 14 | 197.0 | 83.6 | 74 | 252.2 | 107.1 |
| 35 | 32.2 | 13.7 | 95 | 87.4 | 37.1 | 55 | 142.7 | 60.6 | 15 | 197.9 | 84.0 | 75 | 253.1 | 107.5 |
| 36 | 33.1 | 14.1 | 96 | 88.4 | 37.5 | 56 | 143.6 | 61.0 | 16 | 198.8 | 84.4 | 76 | 254.1 | 107.8 |
| 37 | 34.1 | 14.5 | 97 | 89.3 | 37.9 | 57 | 144.5 | 61.3 | 17 | 199.7 | 84.8 | 77 | 255.0 | 108.2 |
| 38 | 35.0 | 14.8 | 98 | 90.2 | 38.3 | 58 | 145.4 | 61.7 | 18 | 200.7 | 85.2 | 78 | 255.9 | 108.6 |
| 39 | 35.9 | 15.2 | 99 | 91.1 | 38.7 | 59 | 146.4 | 62.1 | 19 | 201.6 | 85.6 | 79 | 256.8 | 109.0 |
| 40 | 36.8 | 15.6 | 100 | 92.1 | 39.1 | 60 | 147.3 | 62.5 | 20 | 202.5 | 86.0 | 80 | 257.7 | 109.4 |
| 41 | 37.7 | 16.0 | 101 | 93.0 | 39.5 | 161 | 148.2 | 62.9 | 221 | 203.4 | 86.4 | 281 | 258.7 | 109.8 |
| 42 | 38.7 | 16.4 | 02 | 93.9 | 39.9 | 62 | 149.1 | 63.3 | 22 | 204.4 | 86.7 | 82 | 259.6 | 110.2 |
| 43 | 39.6 | 16.8 | 03 | 94.8 | 40.2 | 63 | 150.0 | 63.7 | 23 | 205.3 | 87.1 | 83 | 260.5 | 110.6 |
| 44 | 40.5 | 17.2 | 04 | 95.7 | 40.6 | 64 | 151.0 | 64.1 | 24 | 206.2 | 87.5 | 84 | 261.4 | 111.0 |
| 45 | 41.4 | 17.6 | 05 | 96.7 | 41.0 | 65 | 151.9 | 64.5 | 25 | 207.1 | 87.9 | 85 | 262.3 | 111.4 |
| 46 | 42.3 | 18.0 | 06 | 97.6 | 41.4 | 66 | 152.8 | 64.9 | 26 | 208.0 | 88.3 | 86 | 263.3 | 111.7 |
| 47 | 43.3 | 18.4 | 07 | 98.5 | 41.8 | 67 | 153.7 | 65.3 | 27 | 209.0 | 88.7 | 87 | 264.2 | 112.1 |
| 48 | 44.2 | 18.8 | 08 | 99.4 | 42.2 | 68 | 154.6 | 65.6 | 28 | 209.9 | 89.1 | 88 | 265.1 | 112.5 |
| 49 | 45.1 | 19.1 | 09 | 100.3 | 42.6 | 69 | 155.6 | 66.0 | 29 | 210.8 | 89.5 | 89 | 266.0 | 112.9 |
| 50 | 46.0 | 19.5 | 10 | 101.3 | 43.0 | 70 | 156.5 | 66.4 | 30 | 211.7 | 89.9 | 90 | 266.9 | 113.3 |
| 51 | 46.9 | 19.9 | 11 | 102.2 | 43.4 | 171 | 157.4 | 66.8 | 231 | 212.6 | 90.3 | 291 | 267.9 | 113.7 |
| 52 | 47.9 | 20.3 | 12 | 103.1 | 43.8 | 72 | 158.3 | 67.2 | 32 | 213.6 | 90.6 | 92 | 268.8 | 114.1 |
| 53 | 48.8 | 20.7 | 13 | 104.0 | 44.2 | 73 | 159.2 | 67.6 | 33 | 214.5 | 91.0 | 93 | 269.7 | 114.5 |
| 54 | 49.7 | 21.1 | 14 | 104.9 | 44.5 | 74 | 160.2 | 68.0 | 34 | 215.4 | 91.4 | 94 | 270.6 | 114.9 |
| 55 | 50.6 | 21.5 | 15 | 105.9 | 44.9 | 75 | 161.1 | 68.4 | 35 | 216.3 | 91.8 | 95 | 271.5 | 115.3 |
| 56 | 51.5 | 21.9 | 16 | 106.8 | 45.3 | 76 | 162.0 | 68.8 | 36 | 217.2 | 92.2 | 96 | 272.5 | 115.7 |
| 57 | 52.5 | 22.3 | 17 | 107.7 | 45.7 | 77 | 162.9 | 69.2 | 37 | 218.2 | 92.6 | 97 | 273.4 | 116.0 |
| 58 | 53.4 | 22.7 | 18 | 108.6 | 46.1 | 78 | 163.8 | 69.6 | 38 | 219.1 | 93.0 | 98 | 274.3 | 116.4 |
| 59 | 54.3 | 23.1 | 19 | 109.5 | 46.5 | 79 | 164.8 | 69.9 | 39 | 220.0 | 93.4 | 99 | 275.2 | 116.8 |
| 60 | 55.2 | 23.4 | 20 | 110.5 | 46.9 | 80 | 165.7 | 70.3 | 40 | 220.9 | 93.8 | 300 | 276.2 | 117.2 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 67 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 24°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|-------|
| 1 | 0.9 | 0.4 | 61 | 55.7 | 24.8 | 121 | 110.5 | 49.2 | 181 | 165.4 | 73.6 | 241 | 220.2 | 98.0 |
| 2 | 1.8 | 0.8 | 62 | 56.6 | 25.2 | 22 | 111.5 | 49.6 | 82 | 166.3 | 74.0 | 42 | 221.1 | 98.4 |
| 3 | 2.7 | 1.2 | 63 | 57.6 | 25.6 | 23 | 112.4 | 50.0 | 83 | 167.2 | 74.4 | 43 | 222.0 | 98.8 |
| 4 | 3.7 | 1.6 | 64 | 58.5 | 26.0 | 24 | 113.3 | 50.4 | 84 | 168.1 | 74.8 | 44 | 222.9 | 99.2 |
| 5 | 4.6 | 2.0 | 65 | 59.4 | 26.4 | 25 | 114.2 | 50.8 | 85 | 169.0 | 75.2 | 45 | 223.8 | 99.7 |
| 6 | 5.5 | 2.4 | 66 | 60.3 | 26.8 | 26 | 115.1 | 51.2 | 86 | 169.9 | 75.7 | 46 | 224.7 | 100.1 |
| 7 | 6.4 | 2.8 | 67 | 61.2 | 27.3 | 27 | 116.0 | 51.7 | 87 | 170.8 | 76.1 | 47 | 225.6 | 100.5 |
| 8 | 7.3 | 3.3 | 68 | 62.1 | 27.7 | 28 | 116.9 | 52.1 | 88 | 171.7 | 76.5 | 48 | 226.6 | 100.9 |
| 9 | 8.2 | 3.7 | 69 | 63.0 | 28.1 | 29 | 117.8 | 52.5 | 89 | 172.7 | 76.9 | 49 | 227.5 | 101.3 |
| 10 | 9.1 | 4.1 | 70 | 63.9 | 28.5 | 30 | 118.8 | 52.9 | 90 | 173.6 | 77.3 | 50 | 228.4 | 101.7 |
| 11 | 10.0 | 4.5 | 71 | 64.9 | 28.9 | 131 | 119.7 | 53.3 | 191 | 174.5 | 77.7 | 251 | 229.3 | 102.1 |
| 12 | 11.0 | 4.9 | 72 | 65.8 | 29.3 | 32 | 120.6 | 53.7 | 92 | 175.4 | 78.1 | 52 | 230.2 | 102.5 |
| 13 | 11.9 | 5.3 | 73 | 66.7 | 29.7 | 33 | 121.5 | 54.1 | 93 | 176.3 | 78.5 | 53 | 231.1 | 102.9 |
| 14 | 12.8 | 5.7 | 74 | 67.6 | 30.1 | 34 | 122.4 | 54.5 | 94 | 177.2 | 78.9 | 54 | 232.0 | 103.3 |
| 15 | 13.7 | 6.1 | 75 | 68.5 | 30.5 | 35 | 123.3 | 54.9 | 95 | 178.1 | 79.3 | 55 | 233.0 | 103.7 |
| 16 | 14.6 | 6.5 | 76 | 69.4 | 30.9 | 36 | 124.2 | 55.3 | 96 | 179.1 | 79.7 | 56 | 233.9 | 104.1 |
| 17 | 15.5 | 6.9 | 77 | 70.3 | 31.3 | 37 | 125.2 | 55.7 | 97 | 180.0 | 80.1 | 57 | 234.8 | 104.5 |
| 18 | 16.4 | 7.3 | 78 | 71.3 | 31.7 | 38 | 126.1 | 56.1 | 98 | 180.9 | 80.5 | 58 | 235.7 | 104.9 |
| 19 | 17.4 | 7.7 | 79 | 72.2 | 32.1 | 39 | 127.0 | 56.5 | 99 | 181.8 | 80.9 | 59 | 236.6 | 105.3 |
| 20 | 18.3 | 8.1 | 80 | 73.1 | 32.5 | 40 | 127.9 | 56.9 | 200 | 182.7 | 81.3 | 60 | 237.5 | 105.8 |
| 21 | 19.2 | 8.5 | 81 | 74.0 | 32.9 | 141 | 128.8 | 57.3 | 201 | 183.6 | 81.8 | 261 | 238.4 | 106.2 |
| 22 | 20.1 | 8.9 | 82 | 74.9 | 33.4 | 42 | 129.7 | 57.8 | 02 | 184.5 | 82.2 | 62 | 239.3 | 106.6 |
| 23 | 21.0 | 9.4 | 83 | 75.8 | 33.8 | 43 | 130.6 | 58.2 | 03 | 185.4 | 82.6 | 63 | 240.3 | 107.0 |
| 24 | 21.9 | 9.8 | 84 | 76.7 | 34.2 | 44 | 131.6 | 58.6 | 04 | 186.4 | 83.0 | 64 | 241.2 | 107.4 |
| 25 | 22.8 | 10.2 | 85 | 77.7 | 34.6 | 45 | 132.5 | 59.0 | 05 | 187.3 | 83.4 | 65 | 242.1 | 107.8 |
| 26 | 23.8 | 10.6 | 86 | 78.6 | 35.0 | 46 | 133.4 | 59.4 | 06 | 188.2 | 83.8 | 66 | 243.0 | 108.2 |
| 27 | 24.7 | 11.0 | 87 | 79.5 | 35.4 | 47 | 134.3 | 59.8 | 07 | 189.1 | 84.2 | 67 | 243.9 | 108.6 |
| 28 | 25.6 | 11.4 | 88 | 80.4 | 35.8 | 48 | 135.2 | 60.2 | 08 | 190.0 | 84.6 | 68 | 244.8 | 109.0 |
| 29 | 26.5 | 11.8 | 89 | 81.3 | 36.2 | 49 | 136.1 | 60.6 | 09 | 190.9 | 85.0 | 69 | 245.7 | 109.4 |
| 30 | 27.4 | 12.2 | 90 | 82.2 | 36.6 | 50 | 137.0 | 61.0 | 10 | 191.8 | 85.4 | 70 | 246.7 | 109.8 |
| 31 | 28.3 | 12.6 | 91 | 83.1 | 37.0 | 151 | 137.9 | 61.4 | 211 | 192.8 | 85.8 | 271 | 247.6 | 110.2 |
| 32 | 29.2 | 13.0 | 92 | 84.0 | 37.4 | 52 | 138.9 | 61.8 | 12 | 193.7 | 86.2 | 72 | 248.5 | 110.6 |
| 33 | 30.1 | 13.4 | 93 | 85.0 | 37.8 | 53 | 139.8 | 62.2 | 13 | 194.6 | 86.6 | 73 | 249.4 | 111.0 |
| 34 | 31.1 | 13.8 | 94 | 85.9 | 38.2 | 54 | 140.7 | 62.6 | 14 | 195.5 | 87.0 | 74 | 250.3 | 111.4 |
| 35 | 32.0 | 14.2 | 95 | 86.8 | 38.6 | 55 | 141.6 | 63.0 | 15 | 196.4 | 87.4 | 75 | 251.2 | 111.9 |
| 36 | 32.9 | 14.6 | 96 | 87.7 | 39.0 | 56 | 142.5 | 63.5 | 16 | 197.3 | 87.9 | 76 | 252.1 | 112.3 |
| 37 | 33.8 | 15.0 | 97 | 88.6 | 39.5 | 57 | 143.4 | 63.9 | 17 | 198.2 | 88.3 | 77 | 253.1 | 112.7 |
| 38 | 34.7 | 15.5 | 98 | 89.5 | 39.9 | 58 | 144.3 | 64.3 | 18 | 199.2 | 88.7 | 78 | 254.0 | 113.1 |
| 39 | 35.6 | 15.9 | 99 | 90.4 | 40.3 | 59 | 145.3 | 64.7 | 19 | 200.1 | 89.1 | 79 | 254.9 | 113.5 |
| 40 | 36.5 | 16.3 | 100 | 91.4 | 40.7 | 60 | 146.2 | 65.1 | 20 | 201.0 | 89.5 | 80 | 255.8 | 113.9 |
| 41 | 37.5 | 16.7 | 101 | 92.3 | 41.1 | 161 | 147.1 | 65.5 | 221 | 201.9 | 89.9 | 281 | 256.7 | 114.3 |
| 42 | 38.4 | 17.1 | 02 | 93.2 | 41.5 | 62 | 148.0 | 65.9 | 22 | 202.8 | 90.3 | 82 | 257.6 | 114.7 |
| 43 | 39.3 | 17.5 | 03 | 94.1 | 41.9 | 63 | 148.9 | 66.3 | 23 | 203.7 | 90.7 | 83 | 258.5 | 115.1 |
| 44 | 40.2 | 17.9 | 04 | 95.0 | 42.3 | 64 | 149.8 | 66.7 | 24 | 204.6 | 91.1 | 84 | 259.4 | 115.5 |
| 45 | 41.1 | 18.3 | 05 | 95.9 | 42.7 | 65 | 150.7 | 67.1 | 25 | 205.5 | 91.5 | 85 | 260.4 | 115.9 |
| 46 | 42.0 | 18.7 | 06 | 96.8 | 43.1 | 66 | 151.6 | 67.5 | 26 | 206.5 | 91.9 | 86 | 261.3 | 116.3 |
| 47 | 42.9 | 19.1 | 07 | 97.7 | 43.5 | 67 | 152.6 | 67.9 | 27 | 207.4 | 92.3 | 87 | 262.2 | 116.7 |
| 48 | 43.9 | 19.5 | 08 | 98.7 | 43.9 | 68 | 153.5 | 68.3 | 28 | 208.3 | 92.7 | 88 | 263.1 | 117.1 |
| 49 | 44.8 | 19.9 | 09 | 99.6 | 44.3 | 69 | 154.4 | 68.7 | 29 | 209.2 | 93.1 | 89 | 264.0 | 117.5 |
| 50 | 45.7 | 20.3 | 10 | 100.5 | 44.7 | 70 | 155.3 | 69.1 | 30 | 210.1 | 93.5 | 90 | 264.9 | 118.0 |
| 51 | 46.6 | 20.7 | 111 | 101.4 | 45.1 | 171 | 156.2 | 69.6 | 231 | 211.0 | 94.0 | 291 | 265.8 | 118.4 |
| 52 | 47.5 | 21.2 | 12 | 102.3 | 45.6 | 72 | 157.1 | 70.0 | 32 | 211.9 | 94.4 | 92 | 266.8 | 118.8 |
| 53 | 48.4 | 21.6 | 13 | 103.2 | 46.0 | 73 | 158.0 | 70.4 | 33 | 212.9 | 94.8 | 93 | 267.7 | 119.2 |
| 54 | 49.3 | 22.0 | 14 | 104.1 | 46.4 | 74 | 159.0 | 70.8 | 34 | 213.8 | 95.2 | 94 | 268.6 | 119.6 |
| 55 | 50.2 | 22.4 | 15 | 105.1 | 46.8 | 75 | 159.9 | 71.2 | 35 | 214.7 | 95.6 | 95 | 269.5 | 120.0 |
| 56 | 51.2 | 22.8 | 16 | 106.0 | 47.2 | 76 | 160.8 | 71.6 | 36 | 215.6 | 96.0 | 96 | 270.4 | 120.4 |
| 57 | 52.1 | 23.2 | 17 | 106.9 | 47.6 | 77 | 161.7 | 72.0 | 37 | 216.5 | 96.4 | 97 | 271.3 | 120.8 |
| 58 | 53.0 | 23.6 | 18 | 107.8 | 48.0 | 78 | 162.6 | 72.4 | 38 | 217.4 | 96.8 | 98 | 272.2 | 121.2 |
| 59 | 53.9 | 24.0 | 19 | 108.7 | 48.4 | 79 | 163.5 | 72.8 | 39 | 218.3 | 97.2 | 99 | 273.2 | 121.6 |
| 60 | 54.8 | 24.4 | 20 | 109.6 | 48.8 | 80 | 164.4 | 73.2 | 40 | 219.3 | 97.6 | 300 | 274.1 | 122.0 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 66 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 25°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.4 | 61 | 55.3 | 25.8 | 121 | 109.7 | 51.1 | 181 | 164.0 | 76.5 | 241 | 218.4 | 108.9 |
| 2 | 1.8 | 0.8 | 62 | 56.2 | 26.2 | 22 | 110.6 | 51.6 | 82 | 164.9 | 76.9 | 42 | 219.3 | 109.2 |
| 3 | 2.7 | 1.3 | 63 | 57.1 | 26.6 | 23 | 111.5 | 52.0 | 83 | 165.9 | 77.3 | 43 | 220.2 | 109.7 |
| 4 | 3.6 | 1.7 | 64 | 58.0 | 27.0 | 24 | 112.4 | 52.4 | 84 | 166.8 | 77.8 | 44 | 221.1 | 110.1 |
| 5 | 4.5 | 2.1 | 65 | 58.9 | 27.5 | 25 | 113.3 | 52.8 | 85 | 167.7 | 78.2 | 45 | 222.0 | 110.5 |
| 6 | 5.4 | 2.5 | 66 | 59.8 | 27.9 | 26 | 114.2 | 53.2 | 86 | 168.6 | 78.6 | 46 | 223.0 | 110.9 |
| 7 | 6.3 | 3.0 | 67 | 60.7 | 28.3 | 27 | 115.1 | 53.7 | 87 | 169.5 | 79.0 | 47 | 223.9 | 111.4 |
| 8 | 7.3 | 3.4 | 68 | 61.6 | 28.7 | 28 | 116.0 | 54.1 | 88 | 170.4 | 79.5 | 48 | 224.8 | 111.8 |
| 9 | 8.2 | 3.8 | 69 | 62.5 | 29.2 | 29 | 116.9 | 54.5 | 89 | 171.3 | 79.9 | 49 | 225.7 | 112.3 |
| 10 | 9.1 | 4.2 | 70 | 63.4 | 29.6 | 30 | 117.8 | 54.9 | 90 | 172.2 | 80.3 | 50 | 226.6 | 112.7 |
| 11 | 10.0 | 4.6 | 71 | 64.3 | 30.0 | 131 | 118.7 | 55.4 | 191 | 173.1 | 80.7 | 251 | 227.5 | 113.1 |
| 12 | 10.9 | 5.1 | 72 | 65.3 | 30.4 | 32 | 119.6 | 55.8 | 92 | 174.0 | 81.1 | 52 | 228.4 | 113.5 |
| 13 | 11.8 | 5.5 | 73 | 66.2 | 30.9 | 33 | 120.5 | 56.2 | 93 | 174.9 | 81.6 | 53 | 229.3 | 113.9 |
| 14 | 12.7 | 5.9 | 74 | 67.1 | 31.3 | 34 | 121.4 | 56.6 | 94 | 175.8 | 82.0 | 54 | 230.2 | 114.3 |
| 15 | 13.6 | 6.3 | 75 | 68.0 | 31.7 | 35 | 122.4 | 57.1 | 95 | 176.7 | 82.4 | 55 | 231.1 | 114.7 |
| 16 | 14.5 | 6.8 | 76 | 68.9 | 32.1 | 36 | 123.3 | 57.5 | 96 | 177.6 | 82.8 | 56 | 232.0 | 115.1 |
| 17 | 15.4 | 7.2 | 77 | 69.8 | 32.5 | 37 | 124.2 | 57.9 | 97 | 178.5 | 83.3 | 57 | 232.9 | 115.5 |
| 18 | 16.3 | 7.6 | 78 | 70.7 | 33.0 | 38 | 125.1 | 58.3 | 98 | 179.4 | 83.7 | 58 | 233.8 | 115.9 |
| 19 | 17.2 | 8.0 | 79 | 71.6 | 33.4 | 39 | 126.0 | 58.7 | 99 | 180.4 | 84.1 | 59 | 234.7 | 116.3 |
| 20 | 18.1 | 8.5 | 80 | 72.5 | 33.8 | 40 | 126.9 | 59.2 | 200 | 181.3 | 84.5 | 60 | 235.6 | 116.7 |
| 21 | 19.0 | 8.9 | 81 | 73.4 | 34.2 | 141 | 127.8 | 59.6 | 201 | 182.2 | 84.9 | 261 | 236.5 | 117.1 |
| 22 | 19.9 | 9.3 | 82 | 74.3 | 34.7 | 42 | 128.7 | 60.0 | 02 | 183.1 | 85.4 | 62 | 237.5 | 117.5 |
| 23 | 20.8 | 9.7 | 83 | 75.2 | 35.1 | 43 | 129.6 | 60.4 | 03 | 184.0 | 85.8 | 63 | 238.4 | 117.9 |
| 24 | 21.8 | 10.1 | 84 | 76.1 | 35.5 | 44 | 130.5 | 60.9 | 04 | 184.9 | 86.2 | 64 | 239.3 | 118.3 |
| 25 | 22.7 | 10.6 | 85 | 77.0 | 35.9 | 45 | 131.4 | 61.3 | 05 | 185.8 | 86.6 | 65 | 240.2 | 118.7 |
| 26 | 23.6 | 11.0 | 86 | 77.9 | 36.3 | 46 | 132.3 | 61.7 | 06 | 186.7 | 87.1 | 66 | 241.1 | 119.1 |
| 27 | 24.5 | 11.4 | 87 | 78.8 | 36.8 | 47 | 133.2 | 62.1 | 07 | 187.6 | 87.5 | 67 | 242.0 | 119.5 |
| 28 | 25.4 | 11.8 | 88 | 79.8 | 37.2 | 48 | 134.1 | 62.5 | 08 | 188.5 | 87.9 | 68 | 242.9 | 119.9 |
| 29 | 26.3 | 12.3 | 89 | 80.7 | 37.6 | 49 | 135.0 | 63.0 | 09 | 189.4 | 88.3 | 69 | 243.8 | 120.3 |
| 30 | 27.2 | 12.7 | 90 | 81.6 | 38.0 | 50 | 135.9 | 63.4 | 10 | 190.3 | 88.7 | 70 | 244.7 | 120.7 |
| 31 | 28.1 | 13.1 | 91 | 82.5 | 38.5 | 151 | 136.9 | 63.8 | 211 | 191.2 | 89.2 | 271 | 245.6 | 121.1 |
| 32 | 29.0 | 13.5 | 92 | 83.4 | 38.9 | 52 | 137.8 | 64.2 | 12 | 192.1 | 89.6 | 72 | 246.5 | 121.5 |
| 33 | 29.9 | 13.9 | 93 | 84.3 | 39.3 | 53 | 138.7 | 64.7 | 13 | 193.0 | 90.0 | 73 | 247.4 | 121.9 |
| 34 | 30.8 | 14.4 | 94 | 85.2 | 39.7 | 54 | 139.6 | 65.1 | 14 | 193.9 | 90.4 | 74 | 248.3 | 122.3 |
| 35 | 31.7 | 14.8 | 95 | 86.1 | 40.1 | 55 | 140.5 | 65.5 | 15 | 194.9 | 90.9 | 75 | 249.2 | 122.7 |
| 36 | 32.6 | 15.2 | 96 | 87.0 | 40.6 | 56 | 141.4 | 65.9 | 16 | 195.8 | 91.3 | 76 | 250.1 | 123.1 |
| 37 | 33.5 | 15.6 | 97 | 87.9 | 41.0 | 57 | 142.3 | 66.4 | 17 | 196.7 | 91.7 | 77 | 251.0 | 123.5 |
| 38 | 34.4 | 16.1 | 98 | 88.8 | 41.4 | 58 | 143.2 | 66.8 | 18 | 197.6 | 92.1 | 78 | 252.0 | 123.9 |
| 39 | 35.3 | 16.5 | 99 | 89.7 | 41.8 | 59 | 144.1 | 67.2 | 19 | 198.5 | 92.6 | 79 | 252.9 | 124.3 |
| 40 | 36.3 | 16.9 | 100 | 90.6 | 42.3 | 60 | 145.0 | 67.6 | 20 | 199.4 | 93.0 | 80 | 253.8 | 124.7 |
| 41 | 37.2 | 17.3 | 101 | 91.5 | 42.7 | 161 | 145.9 | 68.0 | 221 | 200.3 | 93.4 | 281 | 254.7 | 125.1 |
| 42 | 38.1 | 17.7 | 02 | 92.4 | 43.1 | 62 | 146.8 | 68.5 | 22 | 201.2 | 93.8 | 82 | 255.6 | 125.5 |
| 43 | 39.0 | 18.2 | 03 | 93.3 | 43.5 | 63 | 147.7 | 68.9 | 23 | 202.1 | 94.2 | 83 | 256.5 | 125.9 |
| 44 | 39.9 | 18.6 | 04 | 94.3 | 44.0 | 64 | 148.6 | 69.3 | 24 | 203.0 | 94.7 | 84 | 257.4 | 126.3 |
| 45 | 40.8 | 19.0 | 05 | 95.2 | 44.4 | 65 | 149.5 | 69.7 | 25 | 203.9 | 95.1 | 85 | 258.3 | 126.7 |
| 46 | 41.7 | 19.4 | 06 | 96.1 | 44.8 | 66 | 150.4 | 70.2 | 26 | 204.8 | 95.5 | 86 | 259.2 | 127.1 |
| 47 | 42.6 | 19.9 | 07 | 97.0 | 45.2 | 67 | 151.4 | 70.6 | 27 | 205.7 | 95.9 | 87 | 260.1 | 127.5 |
| 48 | 43.5 | 20.3 | 08 | 97.9 | 45.6 | 68 | 152.3 | 71.0 | 28 | 206.6 | 96.4 | 88 | 261.0 | 127.9 |
| 49 | 44.4 | 20.7 | 09 | 98.8 | 46.1 | 69 | 153.2 | 71.4 | 29 | 207.5 | 96.8 | 89 | 261.9 | 128.3 |
| 50 | 45.3 | 21.1 | 10 | 99.7 | 46.5 | 70 | 154.1 | 71.8 | 30 | 208.5 | 97.2 | 90 | 262.8 | 128.7 |
| 51 | 46.2 | 21.6 | 11 | 100.6 | 46.9 | 171 | 155.0 | 72.3 | 231 | 209.4 | 97.6 | 291 | 263.7 | 129.1 |
| 52 | 47.1 | 22.0 | 12 | 101.5 | 47.3 | 72 | 155.9 | 72.7 | 32 | 210.3 | 98.0 | 92 | 264.6 | 129.5 |
| 53 | 48.0 | 22.4 | 13 | 102.4 | 47.8 | 73 | 156.8 | 73.1 | 33 | 211.2 | 98.5 | 93 | 265.5 | 129.9 |
| 54 | 48.9 | 22.8 | 14 | 103.3 | 48.2 | 74 | 157.7 | 73.5 | 34 | 212.1 | 98.9 | 94 | 266.5 | 130.3 |
| 55 | 49.8 | 23.2 | 15 | 104.2 | 48.6 | 75 | 158.6 | 74.0 | 35 | 213.0 | 99.3 | 95 | 267.4 | 130.7 |
| 56 | 50.8 | 23.7 | 16 | 105.1 | 49.0 | 76 | 159.5 | 74.4 | 36 | 213.9 | 99.7 | 96 | 268.3 | 131.1 |
| 57 | 51.7 | 24.1 | 17 | 106.0 | 49.4 | 77 | 160.4 | 74.8 | 37 | 214.8 | 100.2 | 97 | 269.2 | 131.5 |
| 58 | 52.6 | 24.5 | 18 | 106.9 | 49.9 | 78 | 161.3 | 75.2 | 38 | 215.7 | 100.6 | 98 | 270.1 | 131.9 |
| 59 | 53.5 | 24.9 | 19 | 107.8 | 50.3 | 79 | 162.2 | 75.6 | 39 | 216.6 | 101.0 | 99 | 271.0 | 132.3 |
| 60 | 54.4 | 25.4 | 20 | 108.8 | 50.7 | 80 | 163.1 | 76.1 | 40 | 217.5 | 101.4 | 300 | 271.9 | 132.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 65 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 26°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.4 | 61 | 54.8 | 26.7 | 121 | 108.8 | 53.0 | 181 | 162.7 | 79.3 | 241 | 216.6 | 105.6 |
| 2 | 1.8 | 0.9 | 62 | 55.7 | 27.2 | 22 | 109.7 | 53.5 | 82 | 163.6 | 79.8 | 42 | 217.5 | 106.1 |
| 3 | 2.7 | 1.3 | 63 | 56.6 | 27.6 | 23 | 110.6 | 53.9 | 83 | 164.5 | 80.2 | 43 | 218.4 | 106.5 |
| 4 | 3.6 | 1.8 | 64 | 57.5 | 28.1 | 24 | 111.5 | 54.4 | 84 | 165.4 | 80.7 | 44 | 219.3 | 107.0 |
| 5 | 4.5 | 2.2 | 65 | 58.4 | 28.5 | 25 | 112.3 | 54.8 | 85 | 166.3 | 81.1 | 45 | 220.2 | 107.4 |
| 6 | 5.4 | 2.6 | 66 | 59.3 | 28.9 | 26 | 113.2 | 55.2 | 86 | 167.2 | 81.5 | 46 | 221.1 | 107.8 |
| 7 | 6.3 | 3.1 | 67 | 60.2 | 29.4 | 27 | 114.1 | 55.7 | 87 | 168.1 | 82.0 | 47 | 222.0 | 108.3 |
| 8 | 7.2 | 3.5 | 68 | 61.1 | 29.8 | 28 | 115.0 | 56.1 | 88 | 169.0 | 82.4 | 48 | 222.9 | 108.7 |
| 9 | 8.1 | 3.9 | 69 | 62.0 | 30.2 | 29 | 115.9 | 56.5 | 89 | 169.9 | 82.9 | 49 | 223.8 | 109.2 |
| 10 | 9.0 | 4.4 | 70 | 62.9 | 30.7 | 30 | 116.8 | 57.0 | 90 | 170.8 | 83.3 | 50 | 224.7 | 109.6 |
| 11 | 9.9 | 4.8 | 71 | 63.8 | 31.1 | 131 | 117.7 | 57.4 | 191 | 171.7 | 83.7 | 251 | 225.6 | 110.0 |
| 12 | 10.8 | 5.3 | 72 | 64.7 | 31.6 | 32 | 118.6 | 57.9 | 92 | 172.6 | 84.2 | 52 | 226.5 | 110.5 |
| 13 | 11.7 | 5.7 | 73 | 65.6 | 32.0 | 33 | 119.5 | 58.3 | 93 | 173.5 | 84.6 | 53 | 227.4 | 110.9 |
| 14 | 12.6 | 6.1 | 74 | 66.5 | 32.4 | 34 | 120.4 | 58.7 | 94 | 174.4 | 85.0 | 54 | 228.3 | 111.3 |
| 15 | 13.5 | 6.6 | 75 | 67.4 | 32.9 | 35 | 121.3 | 59.2 | 95 | 175.3 | 85.5 | 55 | 229.2 | 111.8 |
| 16 | 14.4 | 7.0 | 76 | 68.3 | 33.3 | 36 | 122.2 | 59.6 | 96 | 176.2 | 85.9 | 56 | 230.1 | 112.2 |
| 17 | 15.3 | 7.5 | 77 | 69.2 | 33.8 | 37 | 123.1 | 60.1 | 97 | 177.1 | 86.4 | 57 | 231.0 | 112.7 |
| 18 | 16.2 | 7.9 | 78 | 70.1 | 34.2 | 38 | 124.0 | 60.5 | 98 | 178.0 | 86.8 | 58 | 231.9 | 113.1 |
| 19 | 17.1 | 8.3 | 79 | 71.0 | 34.6 | 39 | 124.9 | 60.9 | 99 | 178.9 | 87.2 | 59 | 232.8 | 113.5 |
| 20 | 18.0 | 8.8 | 80 | 71.9 | 35.1 | 40 | 125.8 | 61.4 | 200 | 179.8 | 87.7 | 60 | 233.7 | 114.0 |
| 21 | 18.9 | 9.2 | 81 | 72.8 | 35.5 | 141 | 126.7 | 61.8 | 201 | 180.7 | 88.1 | 261 | 234.6 | 114.4 |
| 22 | 19.8 | 9.6 | 82 | 73.7 | 35.9 | 42 | 127.6 | 62.2 | 02 | 181.6 | 88.6 | 62 | 235.5 | 114.9 |
| 23 | 20.7 | 10.1 | 83 | 74.6 | 36.4 | 43 | 128.5 | 62.7 | 03 | 182.5 | 89.0 | 63 | 236.4 | 115.3 |
| 24 | 21.6 | 10.5 | 84 | 75.5 | 36.8 | 44 | 129.4 | 63.1 | 04 | 183.4 | 89.4 | 64 | 237.3 | 115.7 |
| 25 | 22.5 | 11.0 | 85 | 76.4 | 37.3 | 45 | 130.3 | 63.6 | 05 | 184.3 | 89.9 | 65 | 238.2 | 116.2 |
| 26 | 23.4 | 11.4 | 86 | 77.3 | 37.7 | 46 | 131.2 | 64.0 | 06 | 185.2 | 90.3 | 66 | 239.1 | 116.6 |
| 27 | 24.3 | 11.8 | 87 | 78.2 | 38.1 | 47 | 132.1 | 64.4 | 07 | 186.1 | 90.7 | 67 | 240.0 | 117.0 |
| 28 | 25.2 | 12.3 | 88 | 79.1 | 38.6 | 48 | 133.0 | 64.9 | 08 | 186.9 | 91.2 | 68 | 240.9 | 117.5 |
| 29 | 26.1 | 12.7 | 89 | 80.0 | 39.0 | 49 | 133.9 | 65.3 | 09 | 187.8 | 91.6 | 69 | 241.8 | 117.9 |
| 30 | 27.0 | 13.2 | 90 | 80.9 | 39.5 | 50 | 134.8 | 65.8 | 10 | 188.7 | 92.1 | 70 | 242.7 | 118.4 |
| 31 | 27.9 | 13.6 | 91 | 81.8 | 39.9 | 151 | 135.7 | 66.2 | 211 | 189.6 | 92.5 | 271 | 243.6 | 118.8 |
| 32 | 28.8 | 14.0 | 92 | 82.7 | 40.3 | 52 | 136.6 | 66.6 | 12 | 190.5 | 92.9 | 72 | 244.5 | 119.2 |
| 33 | 29.7 | 14.5 | 93 | 83.6 | 40.8 | 53 | 137.5 | 67.1 | 13 | 191.4 | 93.4 | 73 | 245.4 | 119.7 |
| 34 | 30.6 | 14.9 | 94 | 84.5 | 41.2 | 54 | 138.4 | 67.5 | 14 | 192.3 | 93.8 | 74 | 246.3 | 120.1 |
| 35 | 31.5 | 15.3 | 95 | 85.4 | 41.6 | 55 | 139.3 | 67.9 | 15 | 193.2 | 94.2 | 75 | 247.2 | 120.6 |
| 36 | 32.4 | 15.8 | 96 | 86.3 | 42.1 | 56 | 140.2 | 68.4 | 16 | 194.1 | 94.7 | 76 | 248.1 | 121.0 |
| 37 | 33.3 | 16.2 | 97 | 87.2 | 42.5 | 57 | 141.1 | 68.8 | 17 | 195.0 | 95.1 | 77 | 249.0 | 121.4 |
| 38 | 34.2 | 16.7 | 98 | 88.1 | 43.0 | 58 | 142.0 | 69.3 | 18 | 195.9 | 95.6 | 78 | 249.9 | 121.9 |
| 39 | 35.1 | 17.1 | 99 | 89.0 | 43.4 | 59 | 142.9 | 69.7 | 19 | 196.8 | 96.0 | 79 | 250.8 | 122.3 |
| 40 | 36.0 | 17.5 | 100 | 89.9 | 43.8 | 60 | 143.8 | 70.1 | 20 | 197.7 | 96.4 | 80 | 251.7 | 122.7 |
| 41 | 36.9 | 18.0 | 101 | 90.8 | 44.3 | 161 | 144.7 | 70.6 | 221 | 198.6 | 96.9 | 281 | 252.6 | 123.2 |
| 42 | 37.7 | 18.4 | 02 | 91.7 | 44.7 | 62 | 145.6 | 71.0 | 22 | 199.5 | 97.3 | 82 | 253.5 | 123.6 |
| 43 | 38.6 | 18.8 | 03 | 92.6 | 45.2 | 63 | 146.5 | 71.5 | 23 | 200.4 | 97.8 | 83 | 254.4 | 124.1 |
| 44 | 39.5 | 19.3 | 04 | 93.5 | 45.6 | 64 | 147.4 | 71.9 | 24 | 201.3 | 98.2 | 84 | 255.3 | 124.5 |
| 45 | 40.4 | 19.7 | 05 | 94.4 | 46.0 | 65 | 148.3 | 72.3 | 25 | 202.2 | 98.6 | 85 | 256.2 | 124.9 |
| 46 | 41.3 | 20.2 | 06 | 95.3 | 46.5 | 66 | 149.2 | 72.8 | 26 | 203.1 | 99.1 | 86 | 257.1 | 125.4 |
| 47 | 42.2 | 20.6 | 07 | 96.2 | 46.9 | 67 | 150.1 | 73.2 | 27 | 204.0 | 99.5 | 87 | 258.0 | 125.8 |
| 48 | 43.1 | 21.0 | 08 | 97.1 | 47.3 | 68 | 151.0 | 73.6 | 28 | 204.9 | 99.9 | 88 | 258.9 | 126.3 |
| 49 | 44.0 | 21.5 | 09 | 98.0 | 47.8 | 69 | 151.9 | 74.1 | 29 | 205.8 | 100.4 | 89 | 259.8 | 126.7 |
| 50 | 44.9 | 21.9 | 10 | 98.9 | 48.2 | 70 | 152.8 | 74.5 | 30 | 206.7 | 100.8 | 90 | 260.7 | 127.1 |
| 51 | 45.8 | 22.4 | 111 | 99.8 | 48.7 | 171 | 153.7 | 75.0 | 231 | 207.6 | 101.3 | 291 | 261.5 | 127.6 |
| 52 | 46.7 | 22.8 | 12 | 100.7 | 49.1 | 72 | 154.6 | 75.4 | 32 | 208.5 | 101.7 | 92 | 262.4 | 128.0 |
| 53 | 47.6 | 23.2 | 13 | 101.6 | 49.5 | 73 | 155.5 | 75.8 | 33 | 209.4 | 102.1 | 93 | 263.3 | 128.4 |
| 54 | 48.5 | 23.7 | 14 | 102.5 | 50.0 | 74 | 156.4 | 76.3 | 34 | 210.3 | 102.6 | 94 | 264.2 | 128.9 |
| 55 | 49.4 | 24.1 | 15 | 103.4 | 50.4 | 75 | 157.3 | 76.7 | 35 | 211.2 | 103.0 | 95 | 265.1 | 129.3 |
| 56 | 50.3 | 24.5 | 16 | 104.3 | 50.9 | 76 | 158.2 | 77.2 | 36 | 212.1 | 103.5 | 96 | 266.0 | 129.8 |
| 57 | 51.2 | 25.0 | 17 | 105.2 | 51.3 | 77 | 159.1 | 77.6 | 37 | 213.0 | 103.9 | 97 | 266.9 | 130.2 |
| 58 | 52.1 | 25.4 | 18 | 106.1 | 51.7 | 78 | 160.0 | 78.0 | 38 | 213.9 | 104.3 | 98 | 267.8 | 130.6 |
| 59 | 53.0 | 25.9 | 19 | 107.0 | 52.2 | 79 | 160.9 | 78.5 | 39 | 214.8 | 104.8 | 99 | 268.7 | 131.1 |
| 60 | 53.9 | 26.3 | 20 | 107.9 | 52.6 | 80 | 161.8 | 78.9 | 40 | 215.7 | 105.2 | 300 | 269.6 | 131.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 64 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 27°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.5 | 61 | 54.4 | 27.7 | 121 | 107.8 | 54.9 | 181 | 161.3 | 82.2 | 241 | 214.7 | 109.4 |
| 2 | 1.8 | 0.9 | 62 | 55.2 | 28.1 | 22 | 108.7 | 55.4 | 82 | 162.2 | 82.6 | 42 | 215.6 | 109.9 |
| 3 | 2.7 | 1.4 | 63 | 56.1 | 28.6 | 23 | 109.6 | 55.8 | 83 | 163.1 | 83.1 | 43 | 216.5 | 110.3 |
| 4 | 3.6 | 1.8 | 64 | 57.0 | 29.1 | 24 | 110.5 | 56.3 | 84 | 163.9 | 83.5 | 44 | 217.4 | 110.8 |
| 5 | 4.5 | 2.3 | 65 | 57.9 | 29.5 | 25 | 111.4 | 56.7 | 85 | 164.8 | 84.0 | 45 | 218.3 | 111.2 |
| 6 | 5.3 | 2.7 | 66 | 58.8 | 30.0 | 26 | 112.3 | 57.2 | 86 | 165.7 | 84.4 | 46 | 219.2 | 111.7 |
| 7 | 6.2 | 3.2 | 67 | 59.7 | 30.4 | 27 | 113.2 | 57.7 | 87 | 166.6 | 84.9 | 47 | 220.1 | 112.1 |
| 8 | 7.1 | 3.6 | 68 | 60.6 | 30.9 | 28 | 114.0 | 58.1 | 88 | 167.5 | 85.4 | 48 | 221.0 | 112.6 |
| 9 | 8.0 | 4.1 | 69 | 61.5 | 31.3 | 29 | 114.9 | 58.6 | 89 | 168.4 | 85.8 | 49 | 221.9 | 113.0 |
| 10 | 8.9 | 4.5 | 70 | 62.4 | 31.8 | 30 | 115.8 | 59.0 | 90 | 169.3 | 86.3 | 50 | 222.8 | 113.5 |
| 11 | 9.8 | 5.0 | 71 | 63.3 | 32.2 | 131 | 116.7 | 59.5 | 191 | 170.2 | 86.7 | 251 | 223.6 | 114.0 |
| 12 | 10.7 | 5.4 | 72 | 64.2 | 32.7 | 32 | 117.6 | 59.9 | 92 | 171.1 | 87.2 | 52 | 224.5 | 114.4 |
| 13 | 11.6 | 5.9 | 73 | 65.0 | 33.1 | 33 | 118.5 | 60.4 | 93 | 172.0 | 87.6 | 53 | 225.4 | 114.9 |
| 14 | 12.5 | 6.4 | 74 | 65.9 | 33.6 | 34 | 119.4 | 60.8 | 94 | 172.9 | 88.1 | 54 | 226.3 | 115.3 |
| 15 | 13.4 | 6.8 | 75 | 66.8 | 34.0 | 35 | 120.3 | 61.3 | 95 | 173.7 | 88.5 | 55 | 227.2 | 115.8 |
| 16 | 14.3 | 7.3 | 76 | 67.7 | 34.5 | 36 | 121.2 | 61.7 | 96 | 174.6 | 89.0 | 56 | 228.1 | 116.2 |
| 17 | 15.1 | 7.7 | 77 | 68.6 | 35.0 | 37 | 122.1 | 62.2 | 97 | 175.5 | 89.4 | 57 | 229.0 | 116.7 |
| 18 | 16.0 | 8.2 | 78 | 69.5 | 35.4 | 38 | 123.0 | 62.7 | 98 | 176.4 | 89.9 | 58 | 229.9 | 117.1 |
| 19 | 16.9 | 8.6 | 79 | 70.4 | 35.9 | 39 | 123.8 | 63.1 | 99 | 177.3 | 90.3 | 59 | 230.8 | 117.6 |
| 20 | 17.8 | 9.1 | 80 | 71.3 | 36.3 | 40 | 124.7 | 63.6 | 200 | 178.2 | 90.8 | 60 | 231.7 | 118.0 |
| 21 | 18.7 | 9.5 | 81 | 72.2 | 36.8 | 141 | 125.6 | 64.0 | 201 | 179.1 | 91.3 | 261 | 232.6 | 118.5 |
| 22 | 19.6 | 10.0 | 82 | 73.1 | 37.2 | 42 | 126.5 | 64.5 | 02 | 180.0 | 91.7 | 62 | 233.4 | 118.9 |
| 23 | 20.5 | 10.4 | 83 | 74.0 | 37.7 | 43 | 127.4 | 64.9 | 03 | 180.9 | 92.2 | 63 | 234.3 | 119.4 |
| 24 | 21.4 | 10.9 | 84 | 74.8 | 38.1 | 44 | 128.3 | 65.4 | 04 | 181.8 | 92.6 | 64 | 235.2 | 119.9 |
| 25 | 22.3 | 11.3 | 85 | 75.7 | 38.6 | 45 | 129.2 | 65.8 | 05 | 182.7 | 93.1 | 65 | 236.1 | 120.3 |
| 26 | 23.2 | 11.8 | 86 | 76.6 | 39.0 | 46 | 130.1 | 66.3 | 06 | 183.5 | 93.5 | 66 | 237.0 | 120.8 |
| 27 | 24.1 | 12.3 | 87 | 77.5 | 39.5 | 47 | 131.0 | 66.7 | 07 | 184.4 | 94.0 | 67 | 237.9 | 121.2 |
| 28 | 24.9 | 12.7 | 88 | 78.4 | 40.0 | 48 | 131.9 | 67.2 | 08 | 185.3 | 94.4 | 68 | 238.8 | 121.7 |
| 29 | 25.8 | 13.2 | 89 | 79.3 | 40.4 | 49 | 132.8 | 67.6 | 09 | 186.2 | 94.9 | 69 | 239.7 | 122.1 |
| 30 | 26.7 | 13.6 | 90 | 80.2 | 40.9 | 50 | 133.7 | 68.1 | 10 | 187.1 | 95.3 | 70 | 240.6 | 122.6 |
| 31 | 27.6 | 14.1 | 91 | 81.1 | 41.3 | 151 | 134.5 | 68.6 | 211 | 188.0 | 95.8 | 271 | 241.5 | 123.0 |
| 32 | 28.5 | 14.5 | 92 | 82.0 | 41.8 | 52 | 135.4 | 69.0 | 12 | 188.9 | 96.2 | 72 | 242.4 | 123.5 |
| 33 | 29.4 | 15.0 | 93 | 82.9 | 42.2 | 53 | 136.3 | 69.5 | 13 | 189.8 | 96.7 | 73 | 243.2 | 123.9 |
| 34 | 30.3 | 15.4 | 94 | 83.8 | 42.7 | 54 | 137.2 | 69.9 | 14 | 190.7 | 97.2 | 74 | 244.1 | 124.4 |
| 35 | 31.2 | 15.9 | 95 | 84.6 | 43.1 | 55 | 138.1 | 70.4 | 15 | 191.6 | 97.6 | 75 | 245.0 | 124.8 |
| 36 | 32.1 | 16.3 | 96 | 85.5 | 43.6 | 56 | 139.0 | 70.8 | 16 | 192.5 | 98.1 | 76 | 245.9 | 125.3 |
| 37 | 33.0 | 16.8 | 97 | 86.4 | 44.0 | 57 | 139.9 | 71.3 | 17 | 193.3 | 98.5 | 77 | 246.8 | 125.8 |
| 38 | 33.9 | 17.3 | 98 | 87.3 | 44.5 | 58 | 140.8 | 71.7 | 18 | 194.2 | 99.0 | 78 | 247.7 | 126.2 |
| 39 | 34.7 | 17.7 | 99 | 88.2 | 44.9 | 59 | 141.7 | 72.2 | 19 | 195.1 | 99.4 | 79 | 248.6 | 126.7 |
| 40 | 35.6 | 18.2 | 100 | 89.1 | 45.4 | 60 | 142.6 | 72.6 | 20 | 196.0 | 99.9 | 80 | 249.5 | 127.1 |
| 41 | 36.5 | 18.6 | 101 | 90.0 | 45.9 | 161 | 143.5 | 73.1 | 221 | 196.9 | 100.3 | 281 | 250.4 | 127.6 |
| 42 | 37.4 | 19.1 | 02 | 90.9 | 46.3 | 62 | 144.3 | 73.5 | 22 | 197.8 | 100.8 | 82 | 251.3 | 128.0 |
| 43 | 38.3 | 19.5 | 03 | 91.8 | 46.8 | 63 | 145.2 | 74.0 | 23 | 198.7 | 101.2 | 83 | 252.2 | 128.5 |
| 44 | 39.2 | 20.0 | 04 | 92.7 | 47.2 | 64 | 146.1 | 74.5 | 24 | 199.6 | 101.7 | 84 | 253.0 | 128.9 |
| 45 | 40.1 | 20.4 | 05 | 93.6 | 47.7 | 65 | 147.0 | 74.9 | 25 | 200.5 | 102.1 | 85 | 253.9 | 129.4 |
| 46 | 41.0 | 20.9 | 06 | 94.4 | 48.1 | 66 | 147.9 | 75.4 | 26 | 201.4 | 102.6 | 86 | 254.8 | 129.8 |
| 47 | 41.9 | 21.3 | 07 | 95.3 | 48.6 | 67 | 148.8 | 75.8 | 27 | 202.3 | 103.1 | 87 | 255.7 | 130.3 |
| 48 | 42.8 | 21.8 | 08 | 96.2 | 49.0 | 68 | 149.7 | 76.3 | 28 | 203.1 | 103.5 | 88 | 256.6 | 130.7 |
| 49 | 43.7 | 22.2 | 09 | 97.1 | 49.5 | 69 | 150.6 | 76.7 | 29 | 204.0 | 104.0 | 89 | 257.5 | 131.2 |
| 50 | 44.6 | 22.7 | 10 | 98.0 | 49.9 | 70 | 151.5 | 77.2 | 30 | 204.9 | 104.4 | 90 | 258.4 | 131.7 |
| 51 | 45.4 | 23.2 | 111 | 98.9 | 50.4 | 171 | 152.4 | 77.6 | 231 | 205.8 | 104.9 | 291 | 259.3 | 132.1 |
| 52 | 46.3 | 23.6 | 12 | 99.8 | 50.8 | 72 | 153.3 | 78.1 | 32 | 206.7 | 105.3 | 92 | 260.2 | 132.6 |
| 53 | 47.2 | 24.1 | 13 | 100.7 | 51.3 | 73 | 154.1 | 78.5 | 33 | 207.6 | 105.8 | 93 | 261.1 | 133.0 |
| 54 | 48.1 | 24.5 | 14 | 101.6 | 51.8 | 74 | 155.0 | 79.0 | 34 | 208.5 | 106.2 | 94 | 262.0 | 133.5 |
| 55 | 49.0 | 25.0 | 15 | 102.5 | 52.2 | 75 | 155.9 | 79.4 | 35 | 209.4 | 106.7 | 95 | 262.8 | 133.9 |
| 56 | 49.9 | 25.4 | 16 | 103.4 | 52.7 | 76 | 156.8 | 79.9 | 36 | 210.3 | 107.1 | 96 | 263.7 | 134.4 |
| 57 | 50.8 | 25.9 | 17 | 104.2 | 53.1 | 77 | 157.7 | 80.4 | 37 | 211.2 | 107.6 | 97 | 264.6 | 134.8 |
| 58 | 51.7 | 26.3 | 18 | 105.1 | 53.6 | 78 | 158.6 | 80.8 | 38 | 212.1 | 108.0 | 98 | 265.5 | 135.3 |
| 59 | 52.6 | 26.8 | 19 | 106.0 | 54.0 | 79 | 159.5 | 81.3 | 39 | 213.0 | 108.5 | 99 | 266.4 | 135.7 |
| 60 | 53.5 | 27.2 | 20 | 106.9 | 54.5 | 80 | 160.4 | 81.7 | 40 | 213.8 | 109.0 | 300 | 267.3 | 136.2 |

[For 63 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 28°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.5 | 61 | 53.9 | 28.6 | 121 | 106.8 | 56.8 | 181 | 159.8 | 85.0 | 241 | 212.8 | 113.1 |
| 2 | 1.8 | 0.9 | 62 | 54.7 | 29.1 | 22 | 107.7 | 57.3 | 82 | 160.7 | 85.4 | 42 | 213.7 | 113.6 |
| 3 | 2.6 | 1.4 | 63 | 55.6 | 29.6 | 23 | 108.6 | 57.7 | 83 | 161.6 | 85.9 | 43 | 214.6 | 114.1 |
| 4 | 3.5 | 1.9 | 64 | 56.5 | 30.0 | 24 | 109.5 | 58.2 | 84 | 162.5 | 86.4 | 44 | 215.4 | 114.6 |
| 5 | 4.4 | 2.3 | 65 | 57.4 | 30.5 | 25 | 110.4 | 58.7 | 85 | 163.3 | 86.9 | 45 | 216.3 | 115.0 |
| 6 | 5.3 | 2.8 | 66 | 58.3 | 31.0 | 26 | 111.3 | 59.2 | 86 | 164.2 | 87.3 | 46 | 217.2 | 115.5 |
| 7 | 6.2 | 3.3 | 67 | 59.2 | 31.5 | 27 | 112.1 | 59.6 | 87 | 165.1 | 87.8 | 47 | 218.1 | 116.0 |
| 8 | 7.1 | 3.8 | 68 | 60.0 | 31.9 | 28 | 113.0 | 60.1 | 88 | 166.0 | 88.3 | 48 | 219.0 | 116.4 |
| 9 | 7.9 | 4.2 | 69 | 60.9 | 32.4 | 29 | 113.9 | 60.6 | 89 | 166.9 | 88.7 | 49 | 219.9 | 116.9 |
| 10 | 8.8 | 4.7 | 70 | 61.8 | 32.9 | 30 | 114.8 | 61.0 | 90 | 167.8 | 89.2 | 50 | 220.7 | 117.4 |
| 11 | 9.7 | 5.2 | 71 | 62.7 | 33.3 | 131 | 115.7 | 61.5 | 191 | 168.6 | 89.7 | 251 | 221.6 | 117.8 |
| 12 | 10.6 | 5.6 | 72 | 63.6 | 33.8 | 32 | 116.5 | 62.0 | 92 | 169.5 | 90.1 | 52 | 222.5 | 118.3 |
| 13 | 11.5 | 6.1 | 73 | 64.5 | 34.3 | 33 | 117.4 | 62.4 | 93 | 170.4 | 90.6 | 53 | 223.4 | 118.8 |
| 14 | 12.4 | 6.6 | 74 | 65.3 | 34.7 | 34 | 118.3 | 62.9 | 94 | 171.3 | 91.1 | 54 | 224.3 | 119.2 |
| 15 | 13.2 | 7.0 | 75 | 66.2 | 35.2 | 35 | 119.2 | 63.4 | 95 | 172.2 | 91.5 | 55 | 225.2 | 119.7 |
| 16 | 14.1 | 7.5 | 76 | 67.1 | 35.7 | 36 | 120.1 | 63.8 | 96 | 173.1 | 92.0 | 56 | 226.0 | 120.2 |
| 17 | 15.0 | 8.0 | 77 | 68.0 | 36.1 | 37 | 121.0 | 64.3 | 97 | 173.9 | 92.5 | 57 | 226.9 | 120.7 |
| 18 | 15.9 | 8.5 | 78 | 68.9 | 36.6 | 38 | 121.8 | 64.8 | 98 | 174.8 | 93.0 | 58 | 227.8 | 121.1 |
| 19 | 16.8 | 8.9 | 79 | 69.8 | 37.1 | 39 | 122.7 | 65.3 | 99 | 175.7 | 93.4 | 59 | 228.7 | 121.6 |
| 20 | 17.7 | 9.4 | 80 | 70.6 | 37.6 | 40 | 123.6 | 65.7 | 200 | 176.6 | 93.9 | 60 | 229.6 | 122.1 |
| 21 | 18.5 | 9.9 | 81 | 71.5 | 38.0 | 141 | 124.5 | 66.2 | 201 | 177.5 | 94.4 | 61 | 230.4 | 122.5 |
| 22 | 19.4 | 10.3 | 82 | 72.4 | 38.5 | 42 | 125.4 | 66.7 | 02 | 178.4 | 94.8 | 62 | 231.3 | 123.0 |
| 23 | 20.3 | 10.8 | 83 | 73.3 | 39.0 | 43 | 126.3 | 67.1 | 03 | 179.2 | 95.3 | 63 | 232.2 | 123.5 |
| 24 | 21.2 | 11.3 | 84 | 74.2 | 39.4 | 44 | 127.1 | 67.6 | 04 | 180.1 | 95.8 | 64 | 233.1 | 123.9 |
| 25 | 22.1 | 11.7 | 85 | 75.1 | 39.9 | 45 | 128.0 | 68.1 | 05 | 181.0 | 96.2 | 65 | 234.0 | 124.4 |
| 26 | 23.0 | 12.2 | 86 | 75.9 | 40.4 | 46 | 128.9 | 68.5 | 06 | 181.9 | 96.7 | 66 | 234.9 | 124.9 |
| 27 | 23.8 | 12.7 | 87 | 76.8 | 40.8 | 47 | 129.8 | 69.0 | 07 | 182.8 | 97.2 | 67 | 235.7 | 125.3 |
| 28 | 24.7 | 13.1 | 88 | 77.7 | 41.3 | 48 | 130.7 | 69.5 | 08 | 183.7 | 97.7 | 68 | 236.6 | 125.8 |
| 29 | 25.6 | 13.6 | 89 | 78.6 | 41.8 | 49 | 131.6 | 70.0 | 09 | 184.5 | 98.1 | 69 | 237.5 | 126.3 |
| 30 | 26.5 | 14.1 | 90 | 79.5 | 42.3 | 50 | 132.4 | 70.4 | 10 | 185.4 | 98.6 | 70 | 238.4 | 126.8 |
| 31 | 27.4 | 14.6 | 91 | 80.3 | 42.7 | 151 | 133.3 | 70.9 | 211 | 186.3 | 99.1 | 271 | 239.3 | 127.2 |
| 32 | 28.3 | 15.0 | 92 | 81.2 | 43.2 | 52 | 134.2 | 71.4 | 12 | 187.2 | 99.5 | 72 | 240.2 | 127.7 |
| 33 | 29.1 | 15.5 | 93 | 82.1 | 43.7 | 53 | 135.1 | 71.8 | 13 | 188.1 | 100.0 | 73 | 241.0 | 128.2 |
| 34 | 30.0 | 16.0 | 94 | 83.0 | 44.1 | 54 | 136.0 | 72.3 | 14 | 189.0 | 100.5 | 74 | 241.9 | 128.6 |
| 35 | 30.9 | 16.4 | 95 | 83.9 | 44.6 | 55 | 136.9 | 72.8 | 15 | 189.8 | 100.9 | 75 | 242.8 | 129.1 |
| 36 | 31.8 | 16.9 | 96 | 84.8 | 45.1 | 56 | 137.7 | 73.2 | 16 | 190.7 | 101.4 | 76 | 243.7 | 129.6 |
| 37 | 32.7 | 17.4 | 97 | 85.6 | 45.5 | 57 | 138.6 | 73.7 | 17 | 191.6 | 101.9 | 77 | 244.6 | 130.0 |
| 38 | 33.6 | 17.8 | 98 | 86.5 | 46.0 | 58 | 139.5 | 74.2 | 18 | 192.5 | 102.3 | 78 | 245.5 | 130.5 |
| 39 | 34.4 | 18.3 | 99 | 87.4 | 46.5 | 59 | 140.4 | 74.6 | 19 | 193.4 | 102.8 | 79 | 246.3 | 131.0 |
| 40 | 35.3 | 18.8 | 100 | 88.3 | 46.9 | 60 | 141.3 | 75.1 | 20 | 194.2 | 103.3 | 80 | 247.2 | 131.5 |
| 41 | 36.2 | 19.2 | 101 | 89.2 | 47.4 | 161 | 142.2 | 75.6 | 221 | 195.1 | 103.8 | 281 | 248.1 | 131.9 |
| 42 | 37.1 | 19.7 | 02 | 90.1 | 47.9 | 62 | 143.0 | 76.1 | 22 | 196.0 | 104.2 | 82 | 249.0 | 132.4 |
| 43 | 38.0 | 20.2 | 03 | 90.9 | 48.4 | 63 | 143.9 | 76.5 | 23 | 196.9 | 104.7 | 83 | 249.9 | 132.9 |
| 44 | 38.8 | 20.7 | 04 | 91.8 | 48.8 | 64 | 144.8 | 77.0 | 24 | 197.8 | 105.2 | 84 | 250.8 | 133.3 |
| 45 | 39.7 | 21.1 | 05 | 92.7 | 49.3 | 65 | 145.7 | 77.5 | 25 | 198.7 | 105.6 | 85 | 251.6 | 133.8 |
| 46 | 40.6 | 21.6 | 06 | 93.6 | 49.8 | 66 | 146.6 | 77.9 | 26 | 199.5 | 106.1 | 86 | 252.5 | 134.3 |
| 47 | 41.5 | 22.1 | 07 | 94.5 | 50.2 | 67 | 147.5 | 78.4 | 27 | 200.4 | 106.6 | 87 | 253.4 | 134.7 |
| 48 | 42.4 | 22.5 | 08 | 95.4 | 50.7 | 68 | 148.3 | 78.9 | 28 | 201.3 | 107.0 | 88 | 254.3 | 135.2 |
| 49 | 43.3 | 23.0 | 09 | 96.2 | 51.2 | 69 | 149.2 | 79.3 | 29 | 202.2 | 107.5 | 89 | 255.2 | 135.7 |
| 50 | 44.1 | 23.5 | 10 | 97.1 | 51.6 | 70 | 150.1 | 79.8 | 30 | 203.1 | 108.0 | 90 | 256.1 | 136.1 |
| 51 | 45.0 | 23.9 | 111 | 98.0 | 52.1 | 171 | 151.0 | 80.3 | 231 | 204.0 | 108.4 | 291 | 256.9 | 136.6 |
| 52 | 45.9 | 24.4 | 12 | 98.9 | 52.6 | 72 | 151.9 | 80.7 | 32 | 204.8 | 108.9 | 92 | 257.8 | 137.1 |
| 53 | 46.8 | 24.9 | 13 | 99.8 | 53.1 | 73 | 152.7 | 81.2 | 33 | 205.7 | 109.4 | 93 | 258.7 | 137.6 |
| 54 | 47.7 | 25.4 | 14 | 100.7 | 53.5 | 74 | 153.6 | 81.7 | 34 | 206.6 | 109.9 | 94 | 259.6 | 138.0 |
| 55 | 48.6 | 25.8 | 15 | 101.5 | 54.0 | 75 | 154.5 | 82.2 | 35 | 207.5 | 110.3 | 95 | 260.5 | 138.5 |
| 56 | 49.4 | 26.3 | 16 | 102.4 | 54.5 | 76 | 155.4 | 82.6 | 36 | 208.4 | 110.8 | 96 | 261.4 | 139.0 |
| 57 | 50.3 | 26.8 | 17 | 103.3 | 54.9 | 77 | 156.3 | 83.1 | 37 | 209.3 | 111.3 | 97 | 262.2 | 139.4 |
| 58 | 51.2 | 27.2 | 18 | 104.2 | 55.4 | 78 | 157.2 | 83.6 | 38 | 210.1 | 111.7 | 98 | 263.1 | 139.9 |
| 59 | 52.1 | 27.7 | 19 | 105.1 | 55.9 | 79 | 158.0 | 84.0 | 39 | 211.0 | 112.2 | 99 | 264.0 | 140.4 |
| 60 | 53.0 | 28.2 | 20 | 106.0 | 56.3 | 80 | 158.9 | 84.5 | 40 | 211.9 | 112.7 | 300 | 264.9 | 140.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 62 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 20

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.5 | 61 | 53.4 | 29.6 | 121 | 105.8 | 58.7 | 181 | 158.3 | 87.8 | 241 | 210.8 | 116.8 |
| 2 | 1.7 | 1.0 | 62 | 54.2 | 30.1 | 22 | 106.7 | 59.1 | 82 | 159.2 | 88.2 | 42 | 211.7 | 117.3 |
| 3 | 2.6 | 1.5 | 63 | 55.1 | 30.5 | 23 | 107.6 | 59.6 | 83 | 160.1 | 88.7 | 43 | 212.5 | 117.8 |
| 4 | 3.5 | 1.9 | 64 | 56.0 | 31.0 | 24 | 108.5 | 60.1 | 84 | 160.9 | 89.2 | 44 | 213.4 | 118.3 |
| 5 | 4.4 | 2.4 | 65 | 56.9 | 31.5 | 25 | 109.3 | 60.6 | 85 | 161.8 | 89.7 | 45 | 214.3 | 118.8 |
| 6 | 5.2 | 2.9 | 66 | 57.7 | 32.0 | 26 | 110.2 | 61.1 | 86 | 162.7 | 90.2 | 46 | 215.2 | 119.3 |
| 7 | 6.1 | 3.4 | 67 | 58.6 | 32.5 | 27 | 111.1 | 61.6 | 87 | 163.6 | 90.7 | 47 | 216.0 | 119.7 |
| 8 | 7.0 | 3.9 | 68 | 59.5 | 33.0 | 28 | 112.0 | 62.1 | 88 | 164.4 | 91.1 | 48 | 216.9 | 120.2 |
| 9 | 7.9 | 4.4 | 69 | 60.3 | 33.5 | 29 | 112.8 | 62.5 | 89 | 165.3 | 91.6 | 49 | 217.8 | 120.7 |
| 10 | 8.7 | 4.8 | 70 | 61.2 | 33.9 | 30 | 113.7 | 63.0 | 90 | 166.2 | 92.1 | 50 | 218.7 | 121.2 |
| 11 | 9.6 | 5.3 | 71 | 62.1 | 34.4 | 131 | 114.6 | 63.5 | 191 | 167.1 | 92.6 | 251 | 219.5 | 121.7 |
| 12 | 10.5 | 5.8 | 72 | 63.0 | 34.9 | 32 | 115.4 | 64.0 | 92 | 167.9 | 93.1 | 52 | 220.4 | 122.2 |
| 13 | 11.4 | 6.3 | 73 | 63.8 | 35.4 | 33 | 116.3 | 64.5 | 93 | 168.8 | 93.6 | 53 | 221.3 | 122.7 |
| 14 | 12.2 | 6.8 | 74 | 64.7 | 35.9 | 34 | 117.2 | 65.0 | 94 | 169.7 | 94.1 | 54 | 222.2 | 123.1 |
| 15 | 13.1 | 7.3 | 75 | 65.6 | 36.4 | 35 | 118.1 | 65.5 | 95 | 170.6 | 94.5 | 55 | 223.0 | 123.6 |
| 16 | 14.0 | 7.8 | 76 | 66.5 | 36.8 | 36 | 118.9 | 65.9 | 96 | 171.4 | 95.0 | 56 | 223.9 | 124.1 |
| 17 | 14.9 | 8.2 | 77 | 67.3 | 37.3 | 37 | 119.8 | 66.4 | 97 | 172.3 | 95.5 | 57 | 224.8 | 124.6 |
| 18 | 15.7 | 8.7 | 78 | 68.2 | 37.8 | 38 | 120.7 | 66.9 | 98 | 173.2 | 96.0 | 58 | 225.7 | 125.1 |
| 19 | 16.6 | 9.2 | 79 | 69.1 | 38.1 | 39 | 121.6 | 67.4 | 99 | 174.0 | 96.5 | 59 | 226.5 | 125.6 |
| 20 | 17.5 | 9.7 | 80 | 70.0 | 38.8 | 40 | 122.4 | 67.9 | 200 | 174.9 | 97.0 | 60 | 227.4 | 126.1 |
| 21 | 18.4 | 10.2 | 81 | 70.8 | 39.3 | 141 | 123.3 | 68.4 | 201 | 175.8 | 97.4 | 261 | 228.3 | 126.5 |
| 22 | 19.2 | 10.7 | 82 | 71.7 | 39.8 | 42 | 124.2 | 68.8 | 02 | 176.7 | 97.9 | 62 | 229.2 | 127.0 |
| 23 | 20.1 | 11.2 | 83 | 72.6 | 40.2 | 43 | 125.1 | 69.3 | 03 | 177.5 | 98.4 | 63 | 230.0 | 127.5 |
| 24 | 21.0 | 11.6 | 84 | 73.5 | 40.7 | 44 | 125.9 | 69.8 | 04 | 178.4 | 98.9 | 64 | 230.9 | 128.0 |
| 25 | 21.9 | 12.1 | 85 | 74.3 | 41.2 | 45 | 126.8 | 70.3 | 05 | 179.3 | 99.4 | 65 | 231.8 | 128.5 |
| 26 | 22.7 | 12.6 | 86 | 75.2 | 41.7 | 46 | 127.7 | 70.8 | 06 | 180.2 | 99.9 | 66 | 232.6 | 129.0 |
| 27 | 23.6 | 13.1 | 87 | 76.1 | 42.2 | 47 | 128.6 | 71.3 | 07 | 181.0 | 100.4 | 67 | 233.5 | 129.4 |
| 28 | 24.5 | 13.6 | 88 | 77.0 | 42.7 | 48 | 129.4 | 71.8 | 08 | 181.9 | 100.8 | 68 | 234.4 | 129.9 |
| 29 | 25.4 | 14.1 | 89 | 77.8 | 43.1 | 49 | 130.3 | 72.2 | 09 | 182.8 | 101.3 | 69 | 235.3 | 130.4 |
| 30 | 26.2 | 14.5 | 90 | 78.7 | 43.6 | 50 | 131.2 | 72.7 | 10 | 183.7 | 101.8 | 70 | 236.1 | 130.9 |
| 31 | 27.1 | 15.0 | 91 | 79.6 | 44.1 | 151 | 132.1 | 73.2 | 211 | 184.5 | 102.3 | 271 | 237.0 | 131.4 |
| 32 | 28.0 | 15.5 | 92 | 80.5 | 44.6 | 52 | 132.9 | 73.7 | 12 | 185.4 | 102.8 | 72 | 237.9 | 131.9 |
| 33 | 28.9 | 16.0 | 93 | 81.3 | 45.1 | 53 | 133.8 | 74.2 | 13 | 186.3 | 103.3 | 73 | 238.8 | 132.4 |
| 34 | 29.7 | 16.5 | 94 | 82.2 | 45.6 | 54 | 134.7 | 74.7 | 14 | 187.2 | 103.7 | 74 | 239.6 | 132.8 |
| 35 | 30.6 | 17.0 | 95 | 83.1 | 46.1 | 55 | 135.6 | 75.1 | 15 | 188.0 | 104.2 | 75 | 240.5 | 133.3 |
| 36 | 31.5 | 17.5 | 96 | 84.0 | 46.5 | 56 | 136.4 | 75.6 | 16 | 188.9 | 104.7 | 76 | 241.4 | 133.8 |
| 37 | 32.4 | 17.9 | 97 | 84.8 | 47.0 | 57 | 137.3 | 76.1 | 17 | 189.8 | 105.2 | 77 | 242.3 | 134.3 |
| 38 | 33.2 | 18.4 | 98 | 85.7 | 47.5 | 58 | 138.2 | 76.6 | 18 | 190.7 | 105.7 | 78 | 243.1 | 134.8 |
| 39 | 34.1 | 18.9 | 99 | 86.6 | 48.0 | 59 | 139.1 | 77.1 | 19 | 191.5 | 106.2 | 79 | 244.0 | 135.3 |
| 40 | 35.0 | 19.4 | 100 | 87.5 | 48.5 | 60 | 139.9 | 77.6 | 20 | 192.4 | 106.7 | 80 | 244.9 | 135.7 |
| 41 | 35.9 | 19.9 | 101 | 88.3 | 49.0 | 161 | 140.8 | 78.1 | 221 | 193.3 | 107.1 | 281 | 245.8 | 136.2 |
| 42 | 36.7 | 20.4 | 02 | 89.2 | 49.5 | 62 | 141.7 | 78.5 | 22 | 194.2 | 107.6 | 82 | 246.6 | 136.7 |
| 43 | 37.6 | 20.8 | 03 | 90.1 | 49.9 | 63 | 142.6 | 79.0 | 23 | 195.0 | 108.1 | 83 | 247.5 | 137.2 |
| 44 | 38.5 | 21.3 | 04 | 91.0 | 50.4 | 64 | 143.4 | 79.5 | 24 | 195.9 | 108.6 | 84 | 248.4 | 137.7 |
| 45 | 39.4 | 21.8 | 05 | 91.8 | 50.9 | 65 | 144.3 | 80.0 | 25 | 196.8 | 109.1 | 85 | 249.3 | 138.2 |
| 46 | 40.2 | 22.3 | 06 | 92.7 | 51.4 | 66 | 145.2 | 80.5 | 26 | 197.7 | 109.6 | 86 | 250.1 | 138.7 |
| 47 | 41.1 | 22.8 | 07 | 93.6 | 51.9 | 67 | 146.1 | 81.0 | 27 | 198.5 | 110.1 | 87 | 251.0 | 139.1 |
| 48 | 42.0 | 23.3 | 08 | 94.5 | 52.4 | 68 | 146.9 | 81.4 | 28 | 199.4 | 110.5 | 88 | 251.9 | 139.6 |
| 49 | 42.9 | 23.8 | 09 | 95.3 | 52.8 | 69 | 147.8 | 81.9 | 29 | 200.3 | 111.0 | 89 | 252.8 | 140.1 |
| 50 | 43.7 | 24.2 | 10 | 96.2 | 53.3 | 70 | 148.7 | 82.4 | 30 | 201.2 | 111.5 | 90 | 253.6 | 140.6 |
| 51 | 44.6 | 24.7 | 11 | 97.1 | 53.8 | 171 | 149.6 | 82.9 | 231 | 202.0 | 112.0 | 291 | 254.5 | 141.1 |
| 52 | 45.5 | 25.2 | 12 | 98.0 | 54.3 | 72 | 150.4 | 83.4 | 32 | 202.9 | 112.5 | 92 | 255.4 | 141.6 |
| 53 | 46.4 | 25.7 | 13 | 98.8 | 54.8 | 73 | 151.3 | 83.9 | 33 | 203.8 | 113.0 | 93 | 256.3 | 142.0 |
| 54 | 47.2 | 26.2 | 14 | 99.7 | 55.3 | 74 | 152.2 | 84.4 | 34 | 204.7 | 113.4 | 94 | 257.1 | 142.5 |
| 55 | 48.1 | 26.7 | 15 | 100.6 | 55.8 | 75 | 153.1 | 84.8 | 35 | 205.5 | 113.9 | 95 | 258.0 | 143.0 |
| 56 | 49.0 | 27.1 | 16 | 101.5 | 56.2 | 76 | 153.9 | 85.3 | 36 | 206.4 | 114.4 | 96 | 258.9 | 143.5 |
| 57 | 49.9 | 27.6 | 17 | 102.3 | 56.7 | 77 | 154.8 | 85.8 | 37 | 207.3 | 114.9 | 97 | 259.8 | 144.0 |
| 58 | 50.7 | 28.1 | 18 | 103.2 | 57.2 | 78 | 155.7 | 86.3 | 38 | 208.2 | 115.4 | 98 | 260.6 | 144.5 |
| 59 | 51.6 | 28.6 | 19 | 104.1 | 57.7 | 79 | 156.6 | 86.8 | 39 | 209.0 | 115.9 | 99 | 261.5 | 145.0 |
| 60 | 52.5 | 29.1 | 20 | 105.0 | 58.2 | 80 | 157.4 | 87.3 | 40 | 209.9 | 116.4 | 100 | 262.4 | 145.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 61 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 30°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.5 | 61 | 52.8 | 30.5 | 121 | 104.8 | 60.5 | 181 | 156.8 | 90.5 | 241 | 208.7 | 120.5 |
| 2 | 1.7 | 1.0 | 62 | 53.7 | 31.0 | 22 | 105.7 | 61.0 | 82 | 157.6 | 91.0 | 42 | 209.6 | 121.0 |
| 3 | 2.6 | 1.5 | 63 | 54.6 | 31.5 | 23 | 106.5 | 61.5 | 83 | 158.5 | 91.5 | 43 | 210.4 | 121.5 |
| 4 | 3.5 | 2.0 | 64 | 55.4 | 32.0 | 24 | 107.4 | 62.0 | 84 | 159.3 | 92.0 | 44 | 211.3 | 122.0 |
| 5 | 4.3 | 2.5 | 65 | 56.3 | 32.5 | 25 | 108.3 | 62.5 | 85 | 160.2 | 92.5 | 45 | 212.2 | 122.5 |
| 6 | 5.2 | 3.0 | 66 | 57.2 | 33.0 | 26 | 109.1 | 63.0 | 86 | 161.1 | 93.0 | 46 | 213.0 | 123.0 |
| 7 | 6.1 | 3.5 | 67 | 58.0 | 33.5 | 27 | 110.0 | 63.5 | 87 | 161.9 | 93.5 | 47 | 213.9 | 123.5 |
| 8 | 6.9 | 4.0 | 68 | 58.9 | 34.0 | 28 | 110.9 | 64.0 | 88 | 162.8 | 94.0 | 48 | 214.8 | 124.0 |
| 9 | 7.8 | 4.5 | 69 | 59.8 | 34.5 | 29 | 111.7 | 64.5 | 89 | 163.7 | 94.5 | 49 | 215.6 | 124.5 |
| 10 | 8.7 | 5.0 | 70 | 60.6 | 35.0 | 30 | 112.6 | 65.0 | 90 | 164.5 | 95.0 | 50 | 216.5 | 125.0 |
| 11 | 9.5 | 5.5 | 71 | 61.5 | 35.5 | 131 | 113.4 | 65.5 | 191 | 165.4 | 95.5 | 251 | 217.4 | 125.5 |
| 12 | 10.4 | 6.0 | 72 | 62.4 | 36.0 | 32 | 114.3 | 66.0 | 92 | 166.3 | 96.0 | 52 | 218.2 | 126.0 |
| 13 | 11.3 | 6.5 | 73 | 63.2 | 36.5 | 33 | 115.2 | 66.5 | 93 | 167.1 | 96.5 | 53 | 219.1 | 126.5 |
| 14 | 12.1 | 7.0 | 74 | 64.1 | 37.0 | 34 | 116.0 | 67.0 | 94 | 168.0 | 97.0 | 54 | 220.0 | 127.0 |
| 15 | 13.0 | 7.5 | 75 | 65.0 | 37.5 | 35 | 116.9 | 67.5 | 95 | 168.9 | 97.5 | 55 | 220.8 | 127.5 |
| 16 | 13.9 | 8.0 | 76 | 65.8 | 38.0 | 36 | 117.8 | 68.0 | 96 | 169.7 | 98.0 | 56 | 221.7 | 128.0 |
| 17 | 14.7 | 8.5 | 77 | 66.7 | 38.5 | 37 | 118.6 | 68.5 | 97 | 170.6 | 98.5 | 57 | 222.6 | 128.5 |
| 18 | 15.6 | 9.0 | 78 | 67.5 | 39.0 | 38 | 119.5 | 69.0 | 98 | 171.5 | 99.0 | 58 | 223.4 | 129.0 |
| 19 | 16.5 | 9.5 | 79 | 68.4 | 39.5 | 39 | 120.4 | 69.5 | 99 | 172.3 | 99.5 | 59 | 224.3 | 129.5 |
| 20 | 17.3 | 10.0 | 80 | 69.3 | 40.0 | 40 | 121.2 | 70.0 | 200 | 173.2 | 100.0 | 60 | 225.2 | 130.0 |
| 21 | 18.2 | 10.5 | 81 | 70.1 | 40.5 | 141 | 122.1 | 70.5 | 201 | 174.1 | 100.5 | 201 | 226.0 | 130.5 |
| 22 | 19.1 | 11.0 | 82 | 71.0 | 41.0 | 42 | 123.0 | 71.0 | 02 | 174.9 | 101.0 | 62 | 226.9 | 131.0 |
| 23 | 19.9 | 11.5 | 83 | 71.9 | 41.5 | 43 | 123.8 | 71.5 | 03 | 175.8 | 101.5 | 63 | 227.8 | 131.5 |
| 24 | 20.8 | 12.0 | 84 | 72.7 | 42.0 | 44 | 124.7 | 72.0 | 04 | 176.7 | 102.0 | 64 | 228.6 | 132.0 |
| 25 | 21.7 | 12.5 | 85 | 73.6 | 42.5 | 45 | 125.6 | 72.5 | 05 | 177.5 | 102.5 | 65 | 229.5 | 132.5 |
| 26 | 22.5 | 13.0 | 86 | 74.5 | 43.0 | 46 | 126.4 | 73.0 | 06 | 178.4 | 103.0 | 66 | 230.4 | 133.0 |
| 27 | 23.4 | 13.5 | 87 | 75.3 | 43.5 | 47 | 127.3 | 73.5 | 07 | 179.3 | 103.5 | 67 | 231.2 | 133.5 |
| 28 | 24.2 | 14.0 | 88 | 76.2 | 44.0 | 48 | 128.2 | 74.0 | 08 | 180.1 | 104.0 | 68 | 232.1 | 134.0 |
| 29 | 25.1 | 14.5 | 89 | 77.1 | 44.5 | 49 | 129.0 | 74.5 | 09 | 181.0 | 104.5 | 69 | 233.0 | 134.5 |
| 30 | 26.0 | 15.0 | 90 | 77.9 | 45.0 | 50 | 129.9 | 75.0 | 10 | 181.9 | 105.0 | 70 | 233.8 | 135.0 |
| 31 | 26.8 | 15.5 | 91 | 78.8 | 45.5 | 151 | 130.8 | 75.5 | 211 | 182.7 | 105.5 | 271 | 234.7 | 135.5 |
| 32 | 27.7 | 16.0 | 92 | 79.7 | 46.0 | 52 | 131.6 | 76.0 | 12 | 183.6 | 106.0 | 72 | 235.6 | 136.0 |
| 33 | 28.6 | 16.5 | 93 | 80.5 | 46.5 | 53 | 132.5 | 76.5 | 13 | 184.5 | 106.5 | 73 | 236.4 | 136.5 |
| 34 | 29.4 | 17.0 | 94 | 81.4 | 47.0 | 54 | 133.4 | 77.0 | 14 | 185.3 | 107.0 | 74 | 237.3 | 137.0 |
| 35 | 30.3 | 17.5 | 95 | 82.3 | 47.5 | 55 | 134.2 | 77.5 | 15 | 186.2 | 107.5 | 75 | 238.2 | 137.5 |
| 36 | 31.2 | 18.0 | 96 | 83.1 | 48.0 | 56 | 135.1 | 78.0 | 16 | 187.1 | 108.0 | 76 | 239.0 | 138.0 |
| 37 | 32.0 | 18.5 | 97 | 84.0 | 48.5 | 57 | 136.0 | 78.5 | 17 | 187.9 | 108.5 | 77 | 239.9 | 138.5 |
| 38 | 32.9 | 19.0 | 98 | 84.9 | 49.0 | 58 | 136.8 | 79.0 | 18 | 188.8 | 109.0 | 78 | 240.8 | 139.0 |
| 39 | 33.8 | 19.5 | 99 | 85.7 | 49.5 | 59 | 137.7 | 79.5 | 19 | 189.7 | 109.5 | 79 | 241.6 | 139.5 |
| 40 | 34.6 | 20.0 | 100 | 86.6 | 50.0 | 60 | 138.6 | 80.0 | 20 | 190.5 | 110.0 | 80 | 242.5 | 140.0 |
| 41 | 35.5 | 20.5 | 101 | 87.5 | 50.5 | 161 | 139.4 | 80.5 | 221 | 191.4 | 110.5 | 281 | 243.4 | 140.5 |
| 42 | 36.4 | 21.0 | 02 | 88.3 | 51.0 | 62 | 140.3 | 81.0 | 22 | 192.3 | 111.0 | 82 | 244.2 | 141.0 |
| 43 | 37.2 | 21.5 | 03 | 89.2 | 51.5 | 63 | 141.2 | 81.5 | 23 | 193.1 | 111.5 | 83 | 245.1 | 141.5 |
| 44 | 38.1 | 22.0 | 04 | 90.1 | 52.0 | 64 | 142.0 | 82.0 | 24 | 194.0 | 112.0 | 84 | 246.0 | 142.0 |
| 45 | 39.0 | 22.5 | 05 | 90.9 | 52.5 | 65 | 142.9 | 82.5 | 25 | 194.9 | 112.5 | 85 | 246.8 | 142.5 |
| 46 | 39.8 | 23.0 | 06 | 91.8 | 53.0 | 66 | 143.8 | 83.0 | 26 | 195.7 | 113.0 | 86 | 247.7 | 143.0 |
| 47 | 40.7 | 23.5 | 07 | 92.7 | 53.5 | 67 | 144.6 | 83.5 | 27 | 196.6 | 113.5 | 87 | 248.5 | 143.5 |
| 48 | 41.6 | 24.0 | 08 | 93.5 | 54.0 | 68 | 145.5 | 84.0 | 28 | 197.5 | 114.0 | 88 | 249.4 | 144.0 |
| 49 | 42.4 | 24.5 | 09 | 94.4 | 54.5 | 69 | 146.4 | 84.5 | 29 | 198.3 | 114.5 | 89 | 250.3 | 144.5 |
| 50 | 43.3 | 25.0 | 10 | 95.3 | 55.0 | 70 | 147.2 | 85.0 | 30 | 199.2 | 115.0 | 90 | 251.1 | 145.0 |
| 51 | 44.2 | 25.5 | 111 | 96.1 | 55.5 | 171 | 148.1 | 85.5 | 231 | 200.1 | 115.5 | 291 | 252.0 | 145.5 |
| 52 | 45.0 | 26.0 | 12 | 97.0 | 56.0 | 72 | 149.0 | 86.0 | 32 | 200.9 | 116.0 | 92 | 252.9 | 146.0 |
| 53 | 45.9 | 26.5 | 13 | 97.9 | 56.5 | 73 | 149.8 | 86.5 | 33 | 201.8 | 116.5 | 93 | 253.7 | 146.5 |
| 54 | 46.8 | 27.0 | 14 | 98.7 | 57.0 | 74 | 150.7 | 87.0 | 34 | 202.6 | 117.0 | 94 | 254.6 | 147.0 |
| 55 | 47.6 | 27.5 | 15 | 99.6 | 57.5 | 75 | 151.6 | 87.5 | 35 | 203.5 | 117.5 | 95 | 255.5 | 147.5 |
| 56 | 48.5 | 28.0 | 16 | 100.5 | 58.0 | 76 | 152.4 | 88.0 | 36 | 204.4 | 118.0 | 96 | 256.3 | 148.0 |
| 57 | 49.4 | 28.5 | 17 | 101.3 | 58.5 | 77 | 153.3 | 88.5 | 37 | 205.2 | 118.5 | 97 | 257.2 | 148.5 |
| 58 | 50.2 | 29.0 | 18 | 102.2 | 59.0 | 78 | 154.2 | 89.0 | 38 | 206.1 | 119.0 | 98 | 258.1 | 149.0 |
| 59 | 51.1 | 29.5 | 19 | 103.1 | 59.5 | 79 | 155.0 | 89.5 | 39 | 207.0 | 119.5 | 99 | 258.9 | 149.5 |
| 60 | 52.0 | 30.0 | 20 | 103.9 | 60.0 | 80 | 155.9 | 90.0 | 40 | 207.8 | 120.0 | 300 | 259.8 | 150.0 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 60 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 31°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.9 | 0.5 | 61 | 52.3 | 31.4 | 121 | 103.7 | 62.3 | 181 | 155.1 | 93.2 | 241 | 206.6 | 124.1 |
| 2 | 1.7 | 1.0 | 62 | 53.1 | 31.9 | 22 | 104.6 | 62.8 | 82 | 156.0 | 93.7 | 42 | 207.4 | 124.6 |
| 3 | 2.6 | 1.5 | 63 | 54.0 | 32.4 | 23 | 105.4 | 63.3 | 83 | 156.9 | 94.3 | 43 | 208.3 | 125.2 |
| 4 | 3.4 | 2.1 | 64 | 54.9 | 33.0 | 24 | 106.3 | 63.9 | 84 | 157.7 | 94.8 | 44 | 209.1 | 125.7 |
| 5 | 4.3 | 2.6 | 65 | 55.7 | 33.5 | 25 | 107.1 | 64.4 | 85 | 158.6 | 95.3 | 45 | 210.0 | 126.3 |
| 6 | 5.1 | 3.1 | 66 | 56.6 | 34.0 | 26 | 108.0 | 64.9 | 86 | 159.4 | 95.8 | 46 | 210.9 | 126.7 |
| 7 | 6.0 | 3.6 | 67 | 57.4 | 34.5 | 27 | 108.9 | 65.4 | 87 | 160.3 | 96.3 | 47 | 211.7 | 127.2 |
| 8 | 6.9 | 4.1 | 68 | 58.3 | 35.0 | 28 | 109.7 | 65.9 | 88 | 161.1 | 96.8 | 48 | 212.6 | 127.7 |
| 9 | 7.7 | 4.6 | 69 | 59.1 | 35.5 | 29 | 110.6 | 66.4 | 89 | 162.0 | 97.3 | 49 | 213.4 | 128.2 |
| 10 | 8.6 | 5.2 | 70 | 60.0 | 36.1 | 30 | 111.4 | 67.0 | 90 | 162.9 | 97.9 | 50 | 214.3 | 128.8 |
| 11 | 9.4 | 5.7 | 71 | 60.9 | 36.6 | 131 | 112.3 | 67.5 | 191 | 163.7 | 98.4 | 251 | 215.1 | 129.3 |
| 12 | 10.3 | 6.2 | 72 | 61.7 | 37.1 | 32 | 113.1 | 68.0 | 92 | 164.6 | 98.9 | 52 | 216.0 | 129.8 |
| 13 | 11.1 | 6.7 | 73 | 62.6 | 37.6 | 33 | 114.0 | 68.5 | 93 | 165.4 | 99.4 | 53 | 216.9 | 130.3 |
| 14 | 12.0 | 7.2 | 74 | 63.4 | 38.1 | 34 | 114.9 | 69.0 | 94 | 166.3 | 99.9 | 54 | 217.7 | 130.8 |
| 15 | 12.9 | 7.7 | 75 | 64.3 | 38.6 | 35 | 115.7 | 69.5 | 95 | 167.1 | 100.4 | 55 | 218.6 | 131.3 |
| 16 | 13.7 | 8.2 | 76 | 65.1 | 39.1 | 36 | 116.6 | 70.0 | 96 | 168.0 | 100.9 | 56 | 219.4 | 131.8 |
| 17 | 14.6 | 8.8 | 77 | 66.0 | 39.7 | 37 | 117.4 | 70.6 | 97 | 168.9 | 101.5 | 57 | 220.3 | 132.4 |
| 18 | 15.4 | 9.3 | 78 | 66.9 | 40.2 | 38 | 118.3 | 71.1 | 98 | 169.7 | 102.0 | 58 | 221.1 | 132.9 |
| 19 | 16.3 | 9.8 | 79 | 67.7 | 40.7 | 39 | 119.1 | 71.6 | 99 | 170.6 | 102.5 | 59 | 222.0 | 133.4 |
| 20 | 17.1 | 10.3 | 80 | 68.6 | 41.2 | 40 | 120.0 | 72.1 | 200 | 171.4 | 103.0 | 60 | 222.9 | 133.9 |
| 21 | 18.0 | 10.8 | 81 | 69.4 | 41.7 | 141 | 120.9 | 72.6 | 201 | 172.3 | 103.5 | 261 | 223.7 | 134.4 |
| 22 | 18.9 | 11.3 | 82 | 70.3 | 42.2 | 42 | 121.7 | 73.1 | 02 | 173.1 | 104.0 | 62 | 224.6 | 134.9 |
| 23 | 19.7 | 11.8 | 83 | 71.1 | 42.7 | 43 | 122.6 | 73.7 | 03 | 174.0 | 104.6 | 63 | 225.4 | 135.5 |
| 24 | 20.6 | 12.4 | 84 | 72.0 | 43.3 | 44 | 123.4 | 74.2 | 04 | 174.9 | 105.1 | 64 | 226.3 | 136.0 |
| 25 | 21.4 | 12.9 | 85 | 72.9 | 43.8 | 45 | 124.3 | 74.7 | 05 | 175.7 | 105.6 | 65 | 227.1 | 136.5 |
| 26 | 22.3 | 13.4 | 86 | 73.7 | 44.3 | 46 | 125.1 | 75.2 | 06 | 176.6 | 106.1 | 66 | 228.0 | 137.0 |
| 27 | 23.1 | 13.9 | 87 | 74.6 | 44.8 | 47 | 126.0 | 75.7 | 07 | 177.4 | 106.6 | 67 | 228.9 | 137.5 |
| 28 | 24.0 | 14.4 | 88 | 75.4 | 45.3 | 48 | 126.9 | 76.2 | 08 | 178.3 | 107.1 | 68 | 229.7 | 138.0 |
| 29 | 24.9 | 14.9 | 89 | 76.3 | 45.8 | 49 | 127.7 | 76.7 | 09 | 179.1 | 107.6 | 69 | 230.6 | 138.5 |
| 30 | 25.7 | 15.5 | 90 | 77.1 | 46.4 | 50 | 128.6 | 77.3 | 10 | 180.0 | 108.2 | 70 | 231.4 | 139.1 |
| 31 | 26.6 | 16.0 | 91 | 78.0 | 46.9 | 151 | 129.4 | 77.8 | 211 | 180.9 | 108.7 | 271 | 232.3 | 139.6 |
| 32 | 27.4 | 16.5 | 92 | 78.9 | 47.4 | 52 | 130.3 | 78.3 | 12 | 181.7 | 109.2 | 72 | 233.1 | 140.1 |
| 33 | 28.3 | 17.0 | 93 | 79.7 | 47.9 | 53 | 131.1 | 78.8 | 13 | 182.6 | 109.7 | 73 | 234.0 | 140.6 |
| 34 | 29.1 | 17.5 | 94 | 80.6 | 48.4 | 54 | 132.0 | 79.3 | 14 | 183.4 | 110.2 | 74 | 234.9 | 141.1 |
| 35 | 30.0 | 18.0 | 95 | 81.4 | 48.9 | 55 | 132.9 | 79.8 | 15 | 184.3 | 110.7 | 75 | 235.7 | 141.6 |
| 36 | 30.9 | 18.5 | 96 | 82.3 | 49.4 | 56 | 133.7 | 80.3 | 16 | 185.1 | 111.2 | 76 | 236.6 | 142.2 |
| 37 | 31.7 | 19.1 | 97 | 83.1 | 50.0 | 57 | 134.6 | 80.9 | 17 | 186.0 | 111.8 | 77 | 237.4 | 142.7 |
| 38 | 32.6 | 19.6 | 98 | 84.0 | 50.5 | 58 | 135.4 | 81.4 | 18 | 186.9 | 112.3 | 78 | 238.3 | 143.2 |
| 39 | 33.4 | 20.1 | 99 | 84.9 | 51.0 | 59 | 136.3 | 81.9 | 19 | 187.7 | 112.8 | 79 | 239.1 | 143.7 |
| 40 | 34.3 | 20.6 | 100 | 85.7 | 51.5 | 60 | 137.1 | 82.4 | 20 | 188.6 | 113.3 | 80 | 240.0 | 144.2 |
| 41 | 35.1 | 21.1 | 101 | 86.6 | 52.0 | 161 | 138.0 | 82.9 | 221 | 189.4 | 113.8 | 281 | 240.9 | 144.7 |
| 42 | 36.0 | 21.6 | 02 | 87.4 | 52.5 | 62 | 138.9 | 83.4 | 22 | 190.3 | 114.3 | 82 | 241.7 | 145.2 |
| 43 | 36.9 | 22.1 | 03 | 88.3 | 53.0 | 63 | 139.7 | 84.0 | 23 | 191.1 | 114.9 | 83 | 242.6 | 145.8 |
| 44 | 37.7 | 22.7 | 04 | 89.1 | 53.6 | 64 | 140.6 | 84.5 | 24 | 192.0 | 115.4 | 84 | 243.4 | 146.3 |
| 45 | 38.6 | 23.2 | 05 | 90.0 | 54.1 | 65 | 141.4 | 85.0 | 25 | 192.9 | 115.9 | 85 | 244.3 | 146.8 |
| 46 | 39.4 | 23.7 | 06 | 90.9 | 54.6 | 66 | 142.3 | 85.5 | 26 | 193.7 | 116.4 | 86 | 245.1 | 147.3 |
| 47 | 40.3 | 24.2 | 07 | 91.7 | 55.1 | 67 | 143.1 | 86.0 | 27 | 194.6 | 116.9 | 87 | 246.0 | 147.8 |
| 48 | 41.1 | 24.7 | 08 | 92.6 | 55.6 | 68 | 144.0 | 86.5 | 28 | 195.4 | 117.4 | 88 | 246.9 | 148.3 |
| 49 | 42.0 | 25.2 | 09 | 93.4 | 56.1 | 69 | 144.9 | 87.0 | 29 | 196.3 | 117.9 | 89 | 247.7 | 148.8 |
| 50 | 42.9 | 25.8 | 10 | 94.3 | 56.7 | 70 | 145.7 | 87.6 | 30 | 197.1 | 118.5 | 90 | 248.6 | 149.4 |
| 51 | 43.7 | 26.3 | 111 | 95.1 | 57.2 | 171 | 146.6 | 88.1 | 231 | 198.0 | 119.0 | 291 | 249.4 | 149.9 |
| 52 | 44.6 | 26.8 | 12 | 96.0 | 57.7 | 72 | 147.4 | 88.6 | 32 | 198.9 | 119.5 | 92 | 250.3 | 150.4 |
| 53 | 45.4 | 27.3 | 13 | 96.9 | 58.2 | 73 | 148.3 | 89.1 | 33 | 199.7 | 120.0 | 93 | 251.2 | 150.9 |
| 54 | 46.3 | 27.8 | 14 | 97.7 | 58.7 | 74 | 149.1 | 89.6 | 34 | 200.6 | 120.5 | 94 | 252.0 | 151.4 |
| 55 | 47.1 | 28.3 | 15 | 98.6 | 59.2 | 75 | 150.0 | 90.1 | 35 | 201.4 | 121.0 | 95 | 252.9 | 151.9 |
| 56 | 48.0 | 28.8 | 16 | 99.4 | 59.7 | 76 | 150.9 | 90.6 | 36 | 202.3 | 121.5 | 96 | 253.7 | 152.5 |
| 57 | 48.9 | 29.4 | 17 | 100.3 | 60.3 | 77 | 151.7 | 91.2 | 37 | 203.1 | 122.1 | 97 | 254.6 | 153.0 |
| 58 | 49.7 | 29.9 | 18 | 101.1 | 60.8 | 78 | 152.6 | 91.7 | 38 | 204.0 | 122.6 | 98 | 255.4 | 153.5 |
| 59 | 50.6 | 30.4 | 19 | 102.0 | 61.3 | 79 | 153.4 | 92.2 | 39 | 204.9 | 123.1 | 99 | 256.3 | 154.0 |
| 60 | 51.4 | 30.9 | 20 | 102.9 | 61.8 | 80 | 154.3 | 92.7 | 40 | 205.7 | 123.6 | 300 | 257.1 | 154.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 59 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 32°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.5 | 61 | 51.7 | 32.3 | 121 | 102.6 | 64.1 | 181 | 153.5 | 95.9 | 241 | 204.4 | 127.7 |
| 2 | 1.7 | 1.1 | 62 | 52.6 | 32.9 | 22 | 103.5 | 64.7 | 82 | 154.3 | 96.4 | 42 | 205.2 | 128.2 |
| 3 | 2.5 | 1.6 | 63 | 53.4 | 33.4 | 23 | 104.3 | 65.2 | 83 | 155.2 | 97.0 | 43 | 205.1 | 128.8 |
| 4 | 3.4 | 2.1 | 64 | 54.3 | 33.9 | 24 | 105.2 | 65.7 | 84 | 156.0 | 97.5 | 44 | 206.9 | 129.3 |
| 5 | 4.2 | 2.6 | 65 | 55.1 | 34.4 | 25 | 106.0 | 66.2 | 85 | 156.9 | 98.0 | 45 | 207.8 | 129.8 |
| 6 | 5.1 | 3.2 | 66 | 56.0 | 35.0 | 26 | 106.9 | 66.8 | 86 | 157.7 | 98.6 | 46 | 208.6 | 130.4 |
| 7 | 5.9 | 3.7 | 67 | 56.8 | 35.5 | 27 | 107.7 | 67.3 | 87 | 158.6 | 99.1 | 47 | 209.5 | 130.9 |
| 8 | 6.8 | 4.2 | 68 | 57.7 | 36.0 | 28 | 108.6 | 67.8 | 88 | 159.4 | 99.6 | 48 | 210.3 | 131.4 |
| 9 | 7.6 | 4.8 | 69 | 58.5 | 36.6 | 29 | 109.4 | 68.4 | 89 | 160.3 | 100.2 | 49 | 211.2 | 131.9 |
| 10 | 8.5 | 5.3 | 70 | 59.4 | 37.1 | 30 | 110.2 | 68.9 | 90 | 161.1 | 100.7 | 50 | 212.0 | 132.5 |
| 11 | 9.3 | 5.8 | 71 | 60.2 | 37.6 | 131 | 111.1 | 69.4 | 191 | 162.0 | 101.2 | 251 | 212.9 | 133.0 |
| 12 | 10.2 | 6.4 | 72 | 61.1 | 38.2 | 32 | 111.9 | 69.9 | 92 | 162.8 | 101.7 | 52 | 213.7 | 133.5 |
| 13 | 11.0 | 6.9 | 73 | 61.9 | 38.7 | 33 | 112.8 | 70.5 | 93 | 163.7 | 102.3 | 53 | 214.6 | 134.1 |
| 14 | 11.9 | 7.4 | 74 | 62.8 | 39.2 | 34 | 113.6 | 71.0 | 94 | 164.5 | 102.8 | 54 | 215.4 | 134.6 |
| 15 | 12.7 | 7.9 | 75 | 63.6 | 39.7 | 35 | 114.5 | 71.5 | 95 | 165.4 | 103.3 | 55 | 216.3 | 135.1 |
| 16 | 13.6 | 8.5 | 76 | 64.5 | 40.3 | 36 | 115.3 | 72.1 | 96 | 166.2 | 103.9 | 56 | 217.1 | 135.7 |
| 17 | 14.4 | 9.0 | 77 | 65.3 | 40.8 | 37 | 116.2 | 72.6 | 97 | 167.1 | 104.4 | 57 | 217.9 | 136.2 |
| 18 | 15.3 | 9.5 | 78 | 66.1 | 41.3 | 38 | 117.0 | 73.1 | 98 | 167.9 | 104.9 | 58 | 218.8 | 136.7 |
| 19 | 16.1 | 10.1 | 79 | 67.0 | 41.9 | 39 | 117.9 | 73.7 | 99 | 168.8 | 105.9 | 59 | 219.6 | 137.2 |
| 20 | 17.0 | 10.6 | 80 | 67.8 | 42.4 | 40 | 118.7 | 74.2 | 200 | 169.6 | 106.0 | 60 | 220.5 | 137.8 |
| 21 | 17.8 | 11.1 | 81 | 68.7 | 42.9 | 141 | 119.6 | 74.7 | 201 | 170.5 | 106.5 | 261 | 221.3 | 138.3 |
| 22 | 18.7 | 11.7 | 82 | 69.5 | 43.5 | 42 | 120.4 | 75.2 | 02 | 171.3 | 107.0 | 62 | 222.2 | 138.8 |
| 23 | 19.5 | 12.2 | 83 | 70.4 | 44.0 | 43 | 121.3 | 75.8 | 03 | 172.2 | 107.6 | 63 | 223.0 | 139.4 |
| 24 | 20.4 | 12.7 | 84 | 71.2 | 44.5 | 44 | 122.1 | 76.3 | 04 | 173.0 | 108.1 | 64 | 223.9 | 139.9 |
| 25 | 21.2 | 13.2 | 85 | 72.1 | 45.0 | 45 | 123.0 | 76.8 | 05 | 173.8 | 108.6 | 65 | 224.7 | 140.4 |
| 26 | 22.0 | 13.8 | 86 | 72.9 | 45.6 | 46 | 123.8 | 77.4 | 06 | 174.7 | 109.2 | 66 | 225.6 | 141.0 |
| 27 | 22.9 | 14.3 | 87 | 73.8 | 46.1 | 47 | 124.7 | 77.9 | 07 | 175.5 | 109.7 | 67 | 226.4 | 141.5 |
| 28 | 23.7 | 14.8 | 88 | 74.6 | 46.6 | 48 | 125.5 | 78.4 | 08 | 176.4 | 110.2 | 68 | 227.3 | 142.0 |
| 29 | 24.6 | 15.4 | 89 | 75.5 | 47.2 | 49 | 126.4 | 79.0 | 09 | 177.2 | 110.8 | 69 | 228.1 | 142.5 |
| 30 | 25.4 | 15.9 | 90 | 76.3 | 47.7 | 50 | 127.2 | 79.5 | 10 | 178.1 | 111.3 | 70 | 229.0 | 143.1 |
| 31 | 26.3 | 16.4 | 91 | 77.2 | 48.2 | 151 | 128.1 | 80.0 | 211 | 178.9 | 111.8 | 271 | 229.8 | 143.6 |
| 32 | 27.1 | 17.0 | 92 | 78.0 | 48.8 | 52 | 128.9 | 80.5 | 12 | 179.8 | 112.3 | 72 | 230.7 | 144.1 |
| 33 | 28.0 | 17.5 | 93 | 78.9 | 49.3 | 53 | 129.8 | 81.1 | 13 | 180.6 | 112.9 | 73 | 231.5 | 144.7 |
| 34 | 28.8 | 18.0 | 94 | 79.7 | 49.8 | 54 | 130.6 | 81.6 | 14 | 181.5 | 113.4 | 74 | 232.4 | 145.2 |
| 35 | 29.7 | 18.5 | 95 | 80.6 | 50.3 | 55 | 131.4 | 82.1 | 15 | 182.3 | 113.9 | 75 | 233.2 | 145.7 |
| 36 | 30.5 | 19.1 | 96 | 81.4 | 50.9 | 56 | 132.3 | 82.7 | 16 | 183.2 | 114.5 | 76 | 234.1 | 146.3 |
| 37 | 31.4 | 19.6 | 97 | 82.3 | 51.4 | 57 | 133.1 | 83.2 | 17 | 184.0 | 115.0 | 77 | 234.9 | 146.8 |
| 38 | 32.2 | 20.1 | 98 | 83.1 | 51.9 | 58 | 134.0 | 83.7 | 18 | 184.9 | 115.5 | 78 | 235.8 | 147.3 |
| 39 | 33.1 | 20.7 | 99 | 84.0 | 52.5 | 59 | 134.8 | 84.3 | 19 | 185.7 | 116.1 | 79 | 236.6 | 147.8 |
| 40 | 33.9 | 21.2 | 100 | 84.8 | 53.0 | 60 | 135.7 | 84.8 | 20 | 186.6 | 116.6 | 80 | 237.5 | 148.4 |
| 41 | 34.8 | 21.7 | 101 | 85.7 | 53.5 | 161 | 136.5 | 85.3 | 221 | 187.4 | 117.1 | 281 | 238.3 | 148.9 |
| 42 | 35.6 | 22.3 | 02 | 86.5 | 54.1 | 62 | 137.4 | 85.8 | 22 | 188.3 | 117.6 | 82 | 239.1 | 149.4 |
| 43 | 36.5 | 22.8 | 03 | 87.3 | 54.6 | 63 | 138.2 | 86.4 | 23 | 189.1 | 118.2 | 83 | 240.0 | 150.0 |
| 44 | 37.3 | 23.3 | 04 | 88.2 | 55.1 | 64 | 139.1 | 86.9 | 24 | 190.0 | 118.7 | 84 | 240.8 | 150.5 |
| 45 | 38.2 | 23.8 | 05 | 89.0 | 55.6 | 65 | 139.9 | 87.4 | 25 | 190.8 | 119.2 | 85 | 241.7 | 151.0 |
| 46 | 39.0 | 24.4 | 06 | 89.9 | 56.2 | 66 | 140.8 | 88.0 | 26 | 191.7 | 119.8 | 86 | 242.5 | 151.6 |
| 47 | 39.9 | 24.9 | 07 | 90.7 | 56.7 | 67 | 141.6 | 88.5 | 27 | 192.5 | 120.3 | 87 | 243.4 | 152.1 |
| 48 | 40.7 | 25.4 | 08 | 91.6 | 57.2 | 68 | 142.5 | 89.0 | 28 | 193.4 | 120.8 | 88 | 244.2 | 152.6 |
| 49 | 41.6 | 26.0 | 09 | 92.4 | 57.8 | 69 | 143.3 | 89.6 | 29 | 194.2 | 121.4 | 89 | 245.1 | 153.1 |
| 50 | 42.4 | 26.5 | 10 | 93.3 | 58.3 | 70 | 144.2 | 90.1 | 30 | 195.1 | 121.9 | 90 | 245.9 | 153.7 |
| 51 | 43.3 | 27.0 | 111 | 94.1 | 58.8 | 171 | 145.0 | 90.6 | 231 | 195.9 | 122.4 | 291 | 246.8 | 154.2 |
| 52 | 44.1 | 27.6 | 12 | 95.0 | 59.4 | 72 | 145.9 | 91.1 | 32 | 196.7 | 122.9 | 92 | 247.6 | 154.7 |
| 53 | 44.9 | 28.1 | 13 | 95.8 | 59.9 | 73 | 146.7 | 91.7 | 33 | 197.6 | 123.5 | 93 | 248.5 | 155.3 |
| 54 | 45.8 | 28.6 | 14 | 96.7 | 60.4 | 74 | 147.6 | 92.2 | 34 | 198.4 | 124.0 | 94 | 249.3 | 155.8 |
| 55 | 46.6 | 29.1 | 15 | 97.5 | 60.9 | 75 | 148.4 | 92.7 | 35 | 199.3 | 124.5 | 95 | 250.2 | 156.3 |
| 56 | 47.5 | 29.7 | 16 | 98.4 | 61.5 | 76 | 149.3 | 93.3 | 36 | 200.1 | 125.1 | 96 | 251.0 | 156.9 |
| 57 | 48.3 | 30.2 | 17 | 99.2 | 62.0 | 77 | 150.1 | 93.8 | 37 | 201.0 | 125.6 | 97 | 251.9 | 157.4 |
| 58 | 49.2 | 30.7 | 18 | 100.1 | 62.5 | 78 | 151.0 | 94.3 | 38 | 201.8 | 126.1 | 98 | 252.7 | 157.9 |
| 59 | 50.0 | 31.3 | 19 | 100.9 | 63.1 | 79 | 151.8 | 94.9 | 39 | 202.7 | 126.7 | 99 | 253.6 | 158.4 |
| 60 | 50.9 | 31.8 | 20 | 101.8 | 63.6 | 80 | 152.6 | 95.4 | 40 | 203.5 | 127.2 | 300 | 254.4 | 159.0 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 58 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 33°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.5 | 61 | 51.2 | 33.2 | 121 | 101.5 | 65.9 | 181 | 151.8 | 98.6 | 241 | 202.1 | 131.3 |
| 2 | 1.7 | 1.1 | 62 | 52.0 | 33.8 | 23 | 102.3 | 66.4 | 22 | 152.6 | 99.1 | 42 | 203.0 | 131.8 |
| 3 | 2.5 | 1.6 | 63 | 52.8 | 34.3 | 23 | 103.2 | 67.0 | 83 | 153.5 | 99.7 | 43 | 203.8 | 132.3 |
| 4 | 3.4 | 2.2 | 64 | 53.7 | 34.9 | 24 | 104.0 | 67.5 | 84 | 154.3 | 100.2 | 44 | 204.6 | 132.9 |
| 5 | 4.2 | 2.7 | 65 | 54.5 | 35.4 | 25 | 104.8 | 68.1 | 85 | 155.2 | 100.8 | 45 | 205.5 | 133.4 |
| 6 | 5.0 | 3.3 | 66 | 55.4 | 35.9 | 26 | 105.7 | 68.6 | 86 | 156.0 | 101.3 | 46 | 206.3 | 134.0 |
| 7 | 5.9 | 3.8 | 67 | 56.2 | 36.5 | 27 | 106.5 | 69.2 | 87 | 156.8 | 101.8 | 47 | 207.2 | 134.5 |
| 8 | 6.7 | 4.4 | 68 | 57.0 | 37.0 | 28 | 107.3 | 69.7 | 88 | 157.7 | 102.4 | 48 | 208.0 | 135.1 |
| 9 | 7.5 | 4.9 | 69 | 57.9 | 37.6 | 29 | 108.2 | 70.3 | 89 | 158.5 | 102.9 | 49 | 208.8 | 135.6 |
| 10 | 8.4 | 5.4 | 70 | 58.7 | 38.1 | 30 | 109.0 | 70.8 | 90 | 159.3 | 103.5 | 50 | 209.7 | 136.2 |
| 11 | 9.2 | 6.0 | 71 | 59.5 | 38.7 | 131 | 109.9 | 71.3 | 191 | 160.2 | 104.0 | 251 | 210.5 | 136.7 |
| 12 | 10.1 | 6.5 | 72 | 60.4 | 39.2 | 32 | 110.7 | 71.9 | 92 | 161.0 | 104.6 | 52 | 211.3 | 137.2 |
| 13 | 10.9 | 7.1 | 73 | 61.2 | 39.8 | 33 | 111.5 | 72.4 | 93 | 161.9 | 105.1 | 53 | 212.2 | 137.8 |
| 14 | 11.7 | 7.6 | 74 | 62.1 | 40.3 | 34 | 112.4 | 73.0 | 94 | 162.7 | 105.7 | 54 | 213.0 | 138.3 |
| 15 | 12.6 | 8.2 | 75 | 62.9 | 40.8 | 35 | 113.2 | 73.5 | 95 | 163.5 | 106.2 | 55 | 213.9 | 138.9 |
| 16 | 13.4 | 8.7 | 76 | 63.7 | 41.4 | 36 | 114.1 | 74.1 | 96 | 164.4 | 106.7 | 56 | 214.7 | 139.4 |
| 17 | 14.3 | 9.3 | 77 | 64.6 | 41.9 | 37 | 114.9 | 74.6 | 97 | 165.2 | 107.3 | 57 | 215.5 | 140.0 |
| 18 | 15.1 | 9.8 | 78 | 65.4 | 42.5 | 38 | 115.7 | 75.2 | 98 | 166.1 | 107.8 | 58 | 216.4 | 140.5 |
| 19 | 15.9 | 10.3 | 79 | 66.3 | 43.0 | 39 | 116.6 | 75.7 | 99 | 166.9 | 108.4 | 59 | 217.2 | 141.1 |
| 20 | 16.8 | 10.9 | 80 | 67.1 | 43.6 | 40 | 117.4 | 76.2 | 200 | 167.7 | 108.9 | 60 | 218.1 | 141.6 |
| 21 | 17.6 | 11.4 | 81 | 67.9 | 44.1 | 141 | 118.3 | 76.8 | 201 | 168.6 | 109.5 | 261 | 218.9 | 142.2 |
| 22 | 18.5 | 12.0 | 82 | 68.8 | 44.7 | 42 | 119.1 | 77.3 | 02 | 169.4 | 110.0 | 62 | 219.7 | 142.7 |
| 23 | 19.3 | 12.5 | 83 | 69.6 | 45.2 | 43 | 119.9 | 77.9 | 03 | 170.3 | 110.6 | 63 | 220.6 | 143.2 |
| 24 | 20.1 | 13.1 | 84 | 70.4 | 45.7 | 44 | 120.8 | 78.4 | 04 | 171.1 | 111.1 | 64 | 221.4 | 143.8 |
| 25 | 21.0 | 13.6 | 85 | 71.3 | 46.3 | 45 | 121.6 | 79.0 | 05 | 171.9 | 111.7 | 65 | 222.2 | 144.3 |
| 26 | 21.8 | 14.2 | 86 | 72.1 | 46.8 | 46 | 122.4 | 79.5 | 06 | 172.7 | 112.2 | 66 | 223.1 | 144.9 |
| 27 | 22.6 | 14.7 | 87 | 73.0 | 47.4 | 47 | 123.3 | 80.1 | 07 | 173.6 | 112.7 | 67 | 223.9 | 145.4 |
| 28 | 23.5 | 15.2 | 88 | 73.8 | 47.9 | 48 | 124.1 | 80.6 | 08 | 174.4 | 113.3 | 68 | 224.8 | 146.0 |
| 29 | 24.3 | 15.8 | 89 | 74.6 | 48.5 | 49 | 125.0 | 81.2 | 09 | 175.3 | 113.8 | 69 | 225.6 | 146.5 |
| 30 | 25.2 | 16.3 | 90 | 75.5 | 49.0 | 50 | 125.8 | 81.7 | 10 | 176.1 | 114.4 | 70 | 226.4 | 147.1 |
| 31 | 26.0 | 16.9 | 91 | 76.3 | 49.6 | 151 | 126.6 | 82.2 | 211 | 177.0 | 114.9 | 271 | 227.3 | 147.6 |
| 32 | 26.8 | 17.4 | 92 | 77.2 | 50.1 | 52 | 127.5 | 82.8 | 12 | 177.8 | 115.5 | 72 | 228.1 | 148.1 |
| 33 | 27.7 | 18.0 | 93 | 78.0 | 50.7 | 53 | 128.3 | 83.3 | 13 | 178.6 | 116.0 | 73 | 229.0 | 148.7 |
| 34 | 28.5 | 18.5 | 94 | 78.8 | 51.2 | 54 | 129.2 | 83.9 | 14 | 179.5 | 116.6 | 74 | 229.8 | 149.2 |
| 35 | 29.4 | 19.1 | 95 | 79.7 | 51.7 | 55 | 130.0 | 84.4 | 15 | 180.3 | 117.1 | 75 | 230.6 | 149.8 |
| 36 | 30.2 | 19.6 | 96 | 80.5 | 52.3 | 56 | 130.8 | 85.0 | 16 | 181.2 | 117.6 | 76 | 231.5 | 150.3 |
| 37 | 31.0 | 20.2 | 97 | 81.4 | 52.8 | 57 | 131.7 | 85.5 | 17 | 182.0 | 118.2 | 77 | 232.3 | 150.9 |
| 38 | 31.9 | 20.7 | 98 | 82.2 | 53.4 | 58 | 132.5 | 86.1 | 18 | 182.8 | 118.7 | 78 | 233.2 | 151.4 |
| 39 | 32.7 | 21.2 | 99 | 83.0 | 53.9 | 59 | 133.3 | 86.6 | 19 | 183.7 | 119.3 | 79 | 234.0 | 152.0 |
| 40 | 33.5 | 21.8 | 100 | 83.9 | 54.5 | 60 | 134.2 | 87.1 | 20 | 184.5 | 119.8 | 80 | 234.8 | 152.5 |
| 41 | 34.4 | 22.3 | 101 | 84.7 | 55.0 | 161 | 135.0 | 87.7 | 221 | 185.3 | 120.4 | 281 | 235.7 | 153.0 |
| 42 | 35.2 | 22.9 | 02 | 85.5 | 55.6 | 62 | 135.9 | 88.2 | 22 | 186.2 | 120.9 | 82 | 236.5 | 153.6 |
| 43 | 36.1 | 23.4 | 03 | 86.4 | 56.1 | 63 | 136.7 | 88.8 | 23 | 187.0 | 121.5 | 83 | 237.3 | 154.1 |
| 44 | 36.9 | 24.0 | 04 | 87.2 | 56.6 | 64 | 137.5 | 89.3 | 24 | 187.9 | 122.0 | 84 | 238.2 | 154.7 |
| 45 | 37.7 | 24.5 | 05 | 88.1 | 57.2 | 65 | 138.4 | 89.9 | 25 | 188.7 | 122.5 | 85 | 239.0 | 155.2 |
| 46 | 38.6 | 25.1 | 06 | 88.9 | 57.7 | 66 | 139.2 | 90.4 | 26 | 189.5 | 123.1 | 86 | 239.9 | 155.8 |
| 47 | 39.4 | 25.6 | 07 | 89.7 | 58.3 | 67 | 140.1 | 91.0 | 27 | 190.4 | 123.6 | 87 | 240.7 | 156.3 |
| 48 | 40.3 | 26.1 | 08 | 90.6 | 58.8 | 68 | 140.9 | 91.5 | 28 | 191.2 | 124.2 | 88 | 241.5 | 156.9 |
| 49 | 41.1 | 26.7 | 09 | 91.4 | 59.4 | 69 | 141.7 | 92.0 | 29 | 192.1 | 124.7 | 89 | 242.4 | 157.4 |
| 50 | 41.9 | 27.2 | 10 | 92.3 | 59.9 | 70 | 142.6 | 92.6 | 30 | 192.9 | 125.3 | 90 | 243.2 | 157.9 |
| 51 | 42.8 | 27.8 | 111 | 93.1 | 60.5 | 171 | 143.4 | 93.1 | 231 | 193.7 | 125.8 | 291 | 244.1 | 158.5 |
| 52 | 43.6 | 28.3 | 12 | 93.9 | 61.0 | 72 | 144.3 | 93.7 | 32 | 194.6 | 126.4 | 92 | 244.9 | 159.0 |
| 53 | 44.4 | 28.9 | 13 | 94.8 | 61.5 | 73 | 145.1 | 94.2 | 33 | 195.4 | 126.9 | 93 | 245.7 | 159.6 |
| 54 | 45.3 | 29.4 | 14 | 95.6 | 62.1 | 74 | 145.9 | 94.8 | 34 | 196.2 | 127.4 | 94 | 246.6 | 160.1 |
| 55 | 46.1 | 30.0 | 15 | 96.4 | 62.6 | 75 | 146.8 | 95.3 | 35 | 197.1 | 128.0 | 95 | 247.4 | 160.7 |
| 56 | 47.0 | 30.5 | 16 | 97.3 | 63.2 | 76 | 147.6 | 95.9 | 36 | 197.9 | 128.5 | 96 | 248.2 | 161.2 |
| 57 | 47.8 | 31.0 | 17 | 98.1 | 63.7 | 77 | 148.4 | 96.4 | 37 | 198.8 | 129.1 | 97 | 249.1 | 161.8 |
| 58 | 48.6 | 31.6 | 18 | 99.0 | 64.3 | 78 | 149.3 | 96.9 | 38 | 199.6 | 129.6 | 98 | 249.9 | 162.3 |
| 59 | 49.5 | 32.1 | 19 | 99.8 | 64.8 | 79 | 150.1 | 97.5 | 39 | 200.4 | 130.2 | 99 | 250.8 | 162.8 |
| 60 | 50.3 | 32.7 | 20 | 100.6 | 65.4 | 80 | 151.0 | 98.0 | 40 | 201.3 | 130.7 | 200 | 251.6 | 163.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 57 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 31°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 50.6 | 34.1 | 121 | 100.3 | 67.7 | 181 | 150.1 | 101.2 | 241 | 199.8 | 134.8 |
| 2 | 1.7 | 1.1 | 62 | 51.4 | 34.7 | 22 | 101.1 | 68.2 | 82 | 150.9 | 101.8 | 42 | 200.6 | 135.3 |
| 3 | 2.5 | 1.7 | 63 | 52.2 | 35.2 | 23 | 102.0 | 68.8 | 83 | 151.7 | 102.3 | 43 | 201.5 | 135.9 |
| 4 | 3.3 | 2.2 | 64 | 53.1 | 35.8 | 24 | 102.8 | 69.3 | 84 | 152.5 | 102.9 | 44 | 202.3 | 136.4 |
| 5 | 4.1 | 2.8 | 65 | 53.9 | 36.3 | 25 | 103.6 | 69.9 | 85 | 153.4 | 103.5 | 45 | 203.1 | 137.0 |
| 6 | 5.0 | 3.4 | 66 | 54.7 | 36.9 | 26 | 104.5 | 70.5 | 86 | 154.2 | 104.0 | 46 | 203.9 | 137.6 |
| 7 | 5.8 | 3.9 | 67 | 55.5 | 37.5 | 27 | 105.3 | 71.0 | 87 | 155.0 | 104.6 | 47 | 204.8 | 138.1 |
| 8 | 6.6 | 4.5 | 68 | 56.4 | 38.0 | 28 | 106.1 | 71.6 | 88 | 155.9 | 105.1 | 48 | 205.6 | 138.7 |
| 9 | 7.5 | 5.0 | 69 | 57.2 | 38.6 | 29 | 106.9 | 72.1 | 89 | 156.7 | 105.7 | 49 | 206.4 | 139.2 |
| 10 | 8.3 | 5.6 | 70 | 58.0 | 39.1 | 30 | 107.8 | 72.7 | 90 | 157.5 | 106.2 | 50 | 207.3 | 139.8 |
| 11 | 9.1 | 6.2 | 71 | 58.9 | 39.7 | 131 | 108.6 | 73.3 | 191 | 158.3 | 106.8 | 251 | 208.1 | 140.4 |
| 12 | 9.9 | 6.7 | 72 | 59.7 | 40.3 | 32 | 109.4 | 73.8 | 92 | 159.2 | 107.4 | 52 | 208.9 | 140.9 |
| 13 | 10.8 | 7.3 | 73 | 60.5 | 40.8 | 33 | 110.3 | 74.4 | 93 | 160.0 | 107.9 | 53 | 209.7 | 141.5 |
| 14 | 11.6 | 7.8 | 74 | 61.3 | 41.4 | 34 | 111.1 | 74.9 | 94 | 160.8 | 108.5 | 54 | 210.6 | 142.0 |
| 15 | 12.4 | 8.4 | 75 | 62.2 | 41.9 | 35 | 111.9 | 75.5 | 95 | 161.7 | 109.0 | 55 | 211.4 | 142.6 |
| 16 | 13.3 | 8.9 | 76 | 63.0 | 42.5 | 36 | 112.7 | 76.1 | 96 | 162.5 | 109.6 | 56 | 212.2 | 143.2 |
| 17 | 14.1 | 9.5 | 77 | 63.8 | 43.1 | 37 | 113.6 | 76.6 | 97 | 163.3 | 110.2 | 57 | 213.1 | 143.7 |
| 18 | 14.9 | 10.1 | 78 | 64.7 | 43.6 | 38 | 114.4 | 77.2 | 98 | 164.1 | 110.7 | 58 | 213.9 | 144.3 |
| 19 | 15.8 | 10.6 | 79 | 65.5 | 44.2 | 39 | 115.2 | 77.7 | 99 | 165.0 | 111.3 | 59 | 214.7 | 144.8 |
| 20 | 16.6 | 11.2 | 80 | 66.3 | 44.7 | 40 | 116.1 | 78.3 | 200 | 165.8 | 111.8 | 60 | 215.5 | 145.4 |
| 21 | 17.4 | 11.7 | 81 | 67.2 | 45.3 | 141 | 116.9 | 78.8 | 201 | 166.6 | 112.4 | 261 | 216.4 | 145.9 |
| 22 | 18.2 | 12.3 | 82 | 68.0 | 45.9 | 42 | 117.7 | 79.4 | 02 | 167.5 | 113.0 | 62 | 217.2 | 146.5 |
| 23 | 19.1 | 12.9 | 83 | 68.8 | 46.4 | 43 | 118.6 | 80.0 | 03 | 168.3 | 113.5 | 63 | 218.0 | 147.1 |
| 24 | 19.9 | 13.4 | 84 | 69.6 | 47.0 | 44 | 119.4 | 80.5 | 04 | 169.1 | 114.1 | 64 | 218.9 | 147.6 |
| 25 | 20.7 | 14.0 | 85 | 70.5 | 47.5 | 45 | 120.2 | 81.1 | 05 | 170.0 | 114.6 | 65 | 219.7 | 148.2 |
| 26 | 21.6 | 14.5 | 86 | 71.3 | 48.1 | 46 | 121.0 | 81.6 | 06 | 170.8 | 115.2 | 66 | 220.5 | 148.7 |
| 27 | 22.4 | 15.1 | 87 | 72.1 | 48.6 | 47 | 121.9 | 82.2 | 07 | 171.6 | 115.8 | 67 | 221.4 | 149.3 |
| 28 | 23.2 | 15.7 | 88 | 73.0 | 49.2 | 48 | 122.7 | 82.8 | 08 | 172.4 | 116.3 | 68 | 222.2 | 149.9 |
| 29 | 24.0 | 16.2 | 89 | 73.8 | 49.8 | 49 | 123.5 | 83.3 | 09 | 173.3 | 116.9 | 69 | 223.0 | 150.4 |
| 30 | 24.9 | 16.8 | 90 | 74.6 | 50.3 | 50 | 124.4 | 83.9 | 10 | 174.1 | 117.4 | 70 | 223.8 | 151.0 |
| 31 | 25.7 | 17.3 | 91 | 75.4 | 50.9 | 151 | 125.2 | 84.4 | 211 | 174.9 | 118.0 | 271 | 224.7 | 151.5 |
| 32 | 26.5 | 17.9 | 92 | 76.3 | 51.4 | 52 | 126.0 | 85.0 | 12 | 175.8 | 118.5 | 72 | 225.5 | 152.1 |
| 33 | 27.4 | 18.5 | 93 | 77.1 | 52.0 | 53 | 126.8 | 85.6 | 13 | 176.6 | 119.1 | 73 | 226.3 | 152.7 |
| 34 | 28.2 | 19.0 | 94 | 77.9 | 52.6 | 54 | 127.7 | 86.1 | 14 | 177.4 | 119.7 | 74 | 227.2 | 153.2 |
| 35 | 29.0 | 19.6 | 95 | 78.8 | 53.1 | 55 | 128.5 | 86.7 | 15 | 178.2 | 120.2 | 75 | 228.0 | 153.8 |
| 36 | 29.8 | 20.1 | 96 | 79.6 | 53.7 | 56 | 129.3 | 87.2 | 16 | 179.1 | 120.8 | 76 | 228.8 | 154.3 |
| 37 | 30.7 | 20.7 | 97 | 80.4 | 54.2 | 57 | 130.2 | 87.8 | 17 | 179.9 | 121.3 | 77 | 229.6 | 154.9 |
| 38 | 31.5 | 21.2 | 98 | 81.2 | 54.8 | 58 | 131.0 | 88.4 | 18 | 180.7 | 121.9 | 78 | 230.5 | 155.5 |
| 39 | 32.3 | 21.8 | 99 | 82.1 | 55.4 | 59 | 131.8 | 88.9 | 19 | 181.6 | 122.5 | 79 | 231.3 | 156.0 |
| 40 | 33.2 | 22.4 | 100 | 82.9 | 55.9 | 60 | 132.6 | 89.5 | 20 | 182.4 | 123.0 | 80 | 232.1 | 156.6 |
| 41 | 34.0 | 22.9 | 101 | 83.7 | 56.5 | 161 | 133.5 | 90.0 | 221 | 183.2 | 123.6 | 281 | 233.0 | 157.1 |
| 42 | 34.8 | 23.5 | 02 | 84.6 | 57.0 | 62 | 134.3 | 90.6 | 22 | 184.0 | 124.1 | 82 | 233.8 | 157.7 |
| 43 | 35.6 | 24.0 | 03 | 85.4 | 57.6 | 63 | 135.1 | 91.1 | 23 | 184.9 | 124.7 | 83 | 234.6 | 158.3 |
| 44 | 36.5 | 24.6 | 04 | 86.2 | 58.2 | 64 | 136.0 | 91.7 | 24 | 185.7 | 125.3 | 84 | 235.4 | 158.8 |
| 45 | 37.3 | 25.2 | 05 | 87.0 | 58.7 | 65 | 136.8 | 92.3 | 25 | 186.5 | 125.8 | 85 | 236.3 | 159.4 |
| 46 | 38.1 | 25.7 | 06 | 87.9 | 59.3 | 66 | 137.6 | 92.8 | 26 | 187.4 | 126.4 | 86 | 237.1 | 159.9 |
| 47 | 39.0 | 26.3 | 07 | 88.7 | 59.8 | 67 | 138.4 | 93.4 | 27 | 188.2 | 126.9 | 87 | 237.9 | 160.5 |
| 48 | 39.8 | 26.8 | 08 | 89.5 | 60.4 | 68 | 139.3 | 93.9 | 28 | 189.0 | 127.5 | 88 | 238.8 | 161.0 |
| 49 | 40.6 | 27.4 | 09 | 90.4 | 61.0 | 69 | 140.1 | 94.5 | 29 | 189.8 | 128.1 | 89 | 239.6 | 161.6 |
| 50 | 41.5 | 28.0 | 10 | 91.2 | 61.5 | 70 | 140.9 | 95.1 | 30 | 190.7 | 128.6 | 90 | 240.4 | 162.2 |
| 51 | 42.3 | 28.5 | 111 | 92.0 | 62.1 | 171 | 141.8 | 95.6 | 231 | 191.5 | 129.2 | 291 | 241.2 | 162.7 |
| 52 | 43.1 | 29.1 | 12 | 92.9 | 62.6 | 72 | 142.6 | 96.2 | 32 | 192.3 | 129.7 | 92 | 242.1 | 163.3 |
| 53 | 43.9 | 29.6 | 13 | 93.7 | 63.2 | 73 | 143.4 | 96.7 | 33 | 193.2 | 130.3 | 93 | 242.9 | 163.8 |
| 54 | 44.8 | 30.2 | 14 | 94.5 | 63.7 | 74 | 144.3 | 97.3 | 34 | 194.0 | 130.9 | 94 | 243.7 | 164.4 |
| 55 | 45.6 | 30.8 | 15 | 95.3 | 64.3 | 75 | 145.1 | 97.9 | 35 | 194.8 | 131.4 | 95 | 244.6 | 165.0 |
| 56 | 46.4 | 31.3 | 16 | 96.2 | 64.9 | 76 | 145.9 | 98.4 | 36 | 195.7 | 132.0 | 96 | 245.4 | 165.5 |
| 57 | 47.3 | 31.9 | 17 | 97.0 | 65.4 | 77 | 146.7 | 99.0 | 37 | 196.5 | 132.5 | 97 | 246.2 | 166.1 |
| 58 | 48.1 | 32.4 | 18 | 97.8 | 66.0 | 78 | 147.6 | 99.5 | 38 | 197.3 | 133.1 | 98 | 247.1 | 166.6 |
| 59 | 48.9 | 33.0 | 19 | 98.7 | 66.5 | 79 | 148.4 | 100.1 | 39 | 198.1 | 133.6 | 99 | 247.9 | 167.2 |
| 60 | 49.7 | 33.6 | 20 | 99.5 | 67.1 | 80 | 149.2 | 100.7 | 40 | 199.0 | 134.2 | 300 | 248.7 | 167.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 56 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 35°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 50.0 | 35.0 | 121 | 99.1 | 69.4 | 181 | 148.3 | 103.8 | 241 | 197.4 | 138.2 |
| 2 | 1.6 | 1.1 | 62 | 50.8 | 35.6 | 22 | 99.9 | 70.0 | 82 | 149.1 | 104.4 | 42 | 198.2 | 138.8 |
| 3 | 2.5 | 1.7 | 63 | 51.6 | 36.1 | 23 | 100.8 | 70.5 | 83 | 149.9 | 105.0 | 43 | 199.1 | 139.4 |
| 4 | 3.3 | 2.3 | 64 | 52.4 | 36.7 | 24 | 101.6 | 71.1 | 84 | 150.7 | 105.5 | 44 | 199.9 | 140.0 |
| 5 | 4.1 | 2.9 | 65 | 53.2 | 37.3 | 25 | 102.4 | 71.7 | 85 | 151.5 | 106.1 | 45 | 200.7 | 140.5 |
| 6 | 4.9 | 3.4 | 66 | 54.1 | 37.9 | 26 | 103.2 | 72.3 | 86 | 152.4 | 106.7 | 46 | 201.5 | 141.1 |
| 7 | 5.7 | 4.0 | 67 | 54.9 | 38.4 | 27 | 104.0 | 72.8 | 87 | 153.2 | 107.3 | 47 | 202.3 | 141.7 |
| 8 | 6.6 | 4.6 | 68 | 55.7 | 39.0 | 28 | 104.9 | 73.4 | 88 | 154.0 | 107.8 | 48 | 203.1 | 142.2 |
| 9 | 7.4 | 5.2 | 69 | 56.5 | 39.6 | 29 | 105.7 | 74.0 | 89 | 154.8 | 108.4 | 49 | 204.0 | 142.8 |
| 10 | 8.2 | 5.7 | 70 | 57.3 | 40.2 | 30 | 106.5 | 74.6 | 90 | 155.6 | 109.0 | 50 | 204.8 | 143.4 |
| 11 | 9.0 | 6.3 | 71 | 58.2 | 40.7 | 131 | 107.3 | 75.1 | 191 | 156.5 | 109.6 | 251 | 205.6 | 144.0 |
| 12 | 9.8 | 6.9 | 72 | 59.0 | 41.3 | 32 | 108.1 | 75.7 | 92 | 157.3 | 110.1 | 52 | 206.4 | 144.5 |
| 13 | 10.6 | 7.5 | 73 | 59.8 | 41.9 | 33 | 108.9 | 76.3 | 93 | 158.1 | 110.7 | 53 | 207.2 | 145.1 |
| 14 | 11.5 | 8.0 | 74 | 60.6 | 42.4 | 34 | 109.8 | 76.9 | 94 | 158.9 | 111.3 | 54 | 208.1 | 145.7 |
| 15 | 12.3 | 8.6 | 75 | 61.4 | 43.0 | 35 | 110.6 | 77.4 | 95 | 159.7 | 111.8 | 55 | 208.9 | 146.3 |
| 16 | 13.1 | 9.2 | 76 | 62.3 | 43.6 | 36 | 111.4 | 78.0 | 96 | 160.6 | 112.4 | 56 | 209.7 | 146.8 |
| 17 | 13.9 | 9.8 | 77 | 63.1 | 44.2 | 37 | 112.2 | 78.6 | 97 | 161.4 | 113.0 | 57 | 210.5 | 147.4 |
| 18 | 14.7 | 10.3 | 78 | 63.9 | 44.7 | 38 | 113.0 | 79.2 | 98 | 162.2 | 113.6 | 58 | 211.3 | 148.0 |
| 19 | 15.6 | 10.9 | 79 | 64.7 | 45.3 | 39 | 113.9 | 79.7 | 99 | 163.0 | 114.1 | 59 | 212.2 | 148.6 |
| 20 | 16.4 | 11.5 | 80 | 65.5 | 45.9 | 40 | 114.7 | 80.3 | 200 | 163.8 | 114.7 | 60 | 213.0 | 149.1 |
| 21 | 17.2 | 12.0 | 81 | 66.4 | 46.5 | 141 | 115.5 | 80.9 | 201 | 164.6 | 115.3 | 261 | 213.8 | 149.7 |
| 22 | 18.0 | 12.6 | 82 | 67.2 | 47.0 | 42 | 116.3 | 81.4 | 02 | 165.5 | 115.9 | 62 | 214.6 | 150.3 |
| 23 | 18.8 | 13.2 | 83 | 68.0 | 47.6 | 43 | 117.1 | 82.0 | 03 | 166.3 | 116.4 | 63 | 215.4 | 150.9 |
| 24 | 19.7 | 13.8 | 84 | 68.8 | 48.2 | 44 | 118.0 | 82.6 | 04 | 167.1 | 117.0 | 64 | 216.3 | 151.4 |
| 25 | 20.5 | 14.3 | 85 | 69.6 | 48.8 | 45 | 118.8 | 83.2 | 05 | 167.9 | 117.6 | 65 | 217.1 | 152.0 |
| 26 | 21.3 | 14.9 | 86 | 70.4 | 49.3 | 46 | 119.6 | 83.7 | 06 | 168.7 | 118.2 | 66 | 217.9 | 152.6 |
| 27 | 22.1 | 15.5 | 87 | 71.3 | 49.9 | 47 | 120.4 | 84.3 | 07 | 169.6 | 118.7 | 67 | 218.7 | 153.1 |
| 28 | 22.9 | 16.1 | 88 | 72.1 | 50.5 | 48 | 121.2 | 84.9 | 08 | 170.4 | 119.3 | 68 | 219.5 | 153.7 |
| 29 | 23.8 | 16.6 | 89 | 72.9 | 51.0 | 49 | 122.1 | 85.5 | 09 | 171.2 | 119.9 | 69 | 220.4 | 154.3 |
| 30 | 24.6 | 17.2 | 90 | 73.7 | 51.6 | 50 | 122.9 | 86.0 | 10 | 172.0 | 120.5 | 70 | 221.2 | 154.9 |
| 31 | 25.4 | 17.8 | 91 | 74.5 | 52.2 | 151 | 123.7 | 86.6 | 211 | 172.8 | 121.0 | 271 | 222.0 | 155.4 |
| 32 | 26.2 | 18.4 | 92 | 75.4 | 52.8 | 52 | 124.5 | 87.2 | 12 | 173.7 | 121.6 | 72 | 222.8 | 156.0 |
| 33 | 27.0 | 18.9 | 93 | 76.2 | 53.3 | 53 | 125.3 | 87.8 | 13 | 174.5 | 122.2 | 73 | 223.6 | 156.6 |
| 34 | 27.9 | 19.5 | 94 | 77.0 | 53.9 | 54 | 126.1 | 88.3 | 14 | 175.3 | 122.7 | 74 | 224.4 | 157.2 |
| 35 | 28.7 | 20.1 | 95 | 77.8 | 54.5 | 55 | 127.0 | 88.9 | 15 | 176.1 | 123.3 | 75 | 225.3 | 157.7 |
| 36 | 29.5 | 20.6 | 96 | 78.6 | 55.1 | 56 | 127.8 | 89.5 | 16 | 176.9 | 123.9 | 76 | 226.1 | 158.3 |
| 37 | 30.3 | 21.2 | 97 | 79.5 | 55.6 | 57 | 128.6 | 90.1 | 17 | 177.8 | 124.5 | 77 | 226.9 | 158.9 |
| 38 | 31.1 | 21.8 | 98 | 80.3 | 56.2 | 58 | 129.4 | 90.6 | 18 | 178.6 | 125.0 | 78 | 227.7 | 159.5 |
| 39 | 31.9 | 22.4 | 99 | 81.1 | 56.8 | 59 | 130.2 | 91.2 | 19 | 179.4 | 125.6 | 79 | 228.5 | 160.0 |
| 40 | 32.8 | 22.9 | 100 | 81.9 | 57.4 | 60 | 131.1 | 91.8 | 20 | 180.2 | 126.2 | 80 | 229.4 | 160.6 |
| 41 | 33.6 | 23.5 | 101 | 82.7 | 57.9 | 161 | 131.9 | 92.3 | 221 | 181.0 | 126.8 | 281 | 230.2 | 161.2 |
| 42 | 34.4 | 24.1 | 02 | 83.6 | 58.5 | 62 | 132.7 | 92.9 | 22 | 181.9 | 127.3 | 82 | 231.0 | 161.7 |
| 43 | 35.2 | 24.7 | 03 | 84.4 | 59.1 | 63 | 133.5 | 93.5 | 23 | 182.7 | 127.9 | 83 | 231.8 | 162.3 |
| 44 | 36.0 | 25.2 | 04 | 85.2 | 59.7 | 64 | 134.3 | 94.1 | 24 | 183.5 | 128.5 | 84 | 232.6 | 162.9 |
| 45 | 36.9 | 25.8 | 05 | 86.0 | 60.2 | 65 | 135.2 | 94.6 | 25 | 184.3 | 129.1 | 85 | 233.5 | 163.5 |
| 46 | 37.7 | 26.4 | 06 | 86.8 | 60.8 | 66 | 136.0 | 95.2 | 26 | 185.1 | 129.6 | 86 | 234.3 | 164.0 |
| 47 | 38.5 | 27.0 | 07 | 87.6 | 61.4 | 67 | 136.8 | 95.8 | 27 | 185.9 | 130.2 | 87 | 235.1 | 164.6 |
| 48 | 39.3 | 27.5 | 08 | 88.5 | 61.9 | 68 | 137.6 | 96.4 | 28 | 186.8 | 130.8 | 88 | 235.9 | 165.2 |
| 49 | 40.1 | 28.1 | 09 | 89.3 | 62.5 | 69 | 138.4 | 96.9 | 29 | 187.6 | 131.3 | 89 | 236.7 | 165.8 |
| 50 | 41.0 | 28.7 | 10 | 90.1 | 63.1 | 70 | 139.3 | 97.5 | 30 | 188.4 | 131.9 | 90 | 237.6 | 166.3 |
| 51 | 41.8 | 29.3 | 111 | 90.9 | 63.7 | 171 | 140.1 | 98.1 | 231 | 189.2 | 132.5 | 291 | 238.4 | 166.9 |
| 52 | 42.6 | 29.8 | 12 | 91.7 | 64.2 | 72 | 140.9 | 98.7 | 32 | 190.0 | 133.1 | 92 | 239.2 | 167.5 |
| 53 | 43.4 | 30.4 | 13 | 92.6 | 64.8 | 73 | 141.7 | 99.2 | 33 | 190.9 | 133.6 | 93 | 240.0 | 168.1 |
| 54 | 44.2 | 31.0 | 14 | 93.4 | 65.4 | 74 | 142.5 | 99.8 | 34 | 191.7 | 134.2 | 94 | 240.8 | 168.6 |
| 55 | 45.1 | 31.5 | 15 | 94.2 | 66.0 | 75 | 143.4 | 100.4 | 35 | 192.5 | 134.8 | 95 | 241.6 | 169.2 |
| 56 | 45.9 | 32.1 | 16 | 95.0 | 66.5 | 76 | 144.2 | 100.9 | 36 | 193.3 | 135.4 | 96 | 242.5 | 169.8 |
| 57 | 46.7 | 32.7 | 17 | 95.8 | 67.1 | 77 | 145.0 | 101.5 | 37 | 194.1 | 135.9 | 97 | 243.3 | 170.4 |
| 58 | 47.5 | 33.3 | 18 | 96.7 | 67.7 | 78 | 145.8 | 102.1 | 38 | 195.0 | 136.5 | 98 | 244.1 | 170.9 |
| 59 | 48.3 | 33.8 | 19 | 97.5 | 68.3 | 79 | 146.6 | 102.7 | 39 | 195.8 | 137.1 | 99 | 244.9 | 171.5 |
| 60 | 49.1 | 34.4 | 20 | 98.3 | 68.8 | 80 | 147.4 | 103.2 | 40 | 196.6 | 137.7 | 300 | 245.7 | 172.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 55 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 36°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 49.4 | 35.9 | 121 | 97.9 | 71.1 | 181 | 146.4 | 106.4 | 241 | 195.0 | 141.7 |
| 2 | 1.6 | 1.2 | 62 | 50.2 | 36.4 | 22 | 98.7 | 71.7 | 82 | 147.2 | 107.0 | 42 | 195.8 | 142.2 |
| 3 | 2.4 | 1.8 | 63 | 51.0 | 37.0 | 23 | 99.5 | 72.3 | 83 | 148.1 | 107.6 | 43 | 196.6 | 142.8 |
| 4 | 3.2 | 2.4 | 64 | 51.8 | 37.6 | 24 | 100.3 | 72.9 | 84 | 148.9 | 108.2 | 44 | 197.4 | 143.4 |
| 5 | 4.0 | 2.9 | 65 | 52.6 | 38.2 | 25 | 101.1 | 73.5 | 85 | 149.7 | 108.7 | 45 | 198.2 | 144.0 |
| 6 | 4.9 | 3.5 | 66 | 53.4 | 38.8 | 26 | 101.9 | 74.1 | 86 | 150.5 | 109.3 | 46 | 199.0 | 144.6 |
| 7 | 5.7 | 4.1 | 67 | 54.2 | 39.4 | 27 | 102.7 | 74.6 | 87 | 151.3 | 109.9 | 47 | 199.8 | 145.2 |
| 8 | 6.5 | 4.7 | 68 | 55.0 | 40.0 | 28 | 103.6 | 75.2 | 88 | 152.1 | 110.5 | 48 | 200.6 | 145.8 |
| 9 | 7.3 | 5.3 | 69 | 55.8 | 40.6 | 29 | 104.4 | 75.8 | 89 | 152.9 | 111.1 | 49 | 201.4 | 146.4 |
| 10 | 8.1 | 5.9 | 70 | 56.6 | 41.1 | 30 | 105.2 | 76.4 | 90 | 153.7 | 111.7 | 50 | 202.3 | 146.9 |
| 11 | 8.9 | 6.5 | 71 | 57.4 | 41.7 | 131 | 106.0 | 77.0 | 191 | 154.5 | 112.3 | 251 | 203.1 | 147.5 |
| 12 | 9.7 | 7.1 | 72 | 58.2 | 42.3 | 32 | 106.8 | 77.6 | 92 | 155.3 | 112.9 | 52 | 203.9 | 148.1 |
| 13 | 10.5 | 7.6 | 73 | 59.1 | 42.9 | 33 | 107.6 | 78.2 | 93 | 156.1 | 113.4 | 53 | 204.7 | 148.7 |
| 14 | 11.3 | 8.2 | 74 | 59.9 | 43.5 | 34 | 108.4 | 78.8 | 94 | 156.9 | 114.0 | 54 | 205.5 | 149.3 |
| 15 | 12.1 | 8.8 | 75 | 60.7 | 44.1 | 35 | 109.2 | 79.4 | 95 | 157.8 | 114.6 | 55 | 206.3 | 149.9 |
| 16 | 12.9 | 9.4 | 76 | 61.5 | 44.7 | 36 | 110.0 | 79.9 | 96 | 158.6 | 115.2 | 56 | 207.1 | 150.5 |
| 17 | 13.8 | 10.0 | 77 | 62.3 | 45.3 | 37 | 110.8 | 80.5 | 97 | 159.4 | 115.8 | 57 | 207.9 | 151.1 |
| 18 | 14.6 | 10.6 | 78 | 63.1 | 45.8 | 38 | 111.6 | 81.1 | 98 | 160.2 | 116.4 | 58 | 208.7 | 151.6 |
| 19 | 15.4 | 11.2 | 79 | 63.9 | 46.4 | 39 | 112.5 | 81.7 | 99 | 161.0 | 117.0 | 59 | 209.5 | 152.2 |
| 20 | 16.2 | 11.8 | 80 | 64.7 | 47.0 | 40 | 113.3 | 82.3 | 200 | 161.8 | 117.6 | 60 | 210.3 | 152.8 |
| 21 | 17.0 | 12.3 | 81 | 65.5 | 47.6 | 141 | 114.1 | 82.9 | 201 | 162.6 | 118.1 | 261 | 211.2 | 153.4 |
| 22 | 17.8 | 12.9 | 82 | 66.3 | 48.2 | 42 | 114.9 | 83.5 | 02 | 163.4 | 118.7 | 62 | 212.0 | 154.0 |
| 23 | 18.6 | 13.5 | 83 | 67.1 | 48.8 | 43 | 115.7 | 84.1 | 03 | 164.2 | 119.3 | 63 | 212.8 | 154.6 |
| 24 | 19.4 | 14.1 | 84 | 68.0 | 49.4 | 44 | 116.5 | 84.6 | 04 | 165.0 | 119.9 | 64 | 213.6 | 155.2 |
| 25 | 20.2 | 14.7 | 85 | 68.8 | 50.0 | 45 | 117.3 | 85.2 | 05 | 165.8 | 120.5 | 65 | 214.4 | 155.8 |
| 26 | 21.0 | 15.3 | 86 | 69.6 | 50.5 | 46 | 118.1 | 85.8 | 06 | 166.7 | 121.1 | 66 | 215.2 | 156.4 |
| 27 | 21.8 | 15.9 | 87 | 70.4 | 51.1 | 47 | 118.9 | 86.4 | 07 | 167.5 | 121.7 | 67 | 216.0 | 156.9 |
| 28 | 22.7 | 16.5 | 88 | 71.2 | 51.7 | 48 | 119.7 | 87.0 | 08 | 168.3 | 122.3 | 68 | 216.8 | 157.5 |
| 29 | 23.5 | 17.0 | 89 | 72.0 | 52.3 | 49 | 120.5 | 87.6 | 09 | 169.1 | 122.8 | 69 | 217.6 | 158.1 |
| 30 | 24.3 | 17.6 | 90 | 72.8 | 52.9 | 50 | 121.4 | 88.2 | 10 | 169.9 | 123.4 | 70 | 218.4 | 158.7 |
| 31 | 25.1 | 18.2 | 91 | 73.6 | 53.5 | 151 | 122.2 | 88.8 | 211 | 170.7 | 124.0 | 271 | 219.2 | 159.3 |
| 32 | 25.9 | 18.8 | 92 | 74.4 | 54.1 | 52 | 123.0 | 89.3 | 12 | 171.5 | 124.6 | 72 | 220.1 | 159.9 |
| 33 | 26.7 | 19.4 | 93 | 75.2 | 54.7 | 53 | 123.8 | 89.9 | 13 | 172.3 | 125.2 | 73 | 220.9 | 160.5 |
| 34 | 27.5 | 20.0 | 94 | 76.0 | 55.3 | 54 | 124.6 | 90.5 | 14 | 173.1 | 125.8 | 74 | 221.7 | 161.1 |
| 35 | 28.3 | 20.6 | 95 | 76.9 | 55.8 | 55 | 125.4 | 91.1 | 15 | 173.9 | 126.4 | 75 | 222.5 | 161.6 |
| 36 | 29.1 | 21.2 | 96 | 77.7 | 56.4 | 56 | 126.2 | 91.7 | 16 | 174.7 | 127.0 | 76 | 223.3 | 162.2 |
| 37 | 29.9 | 21.7 | 97 | 78.5 | 57.0 | 57 | 127.0 | 92.3 | 17 | 175.6 | 127.5 | 77 | 224.1 | 162.8 |
| 38 | 30.7 | 22.3 | 98 | 79.3 | 57.6 | 58 | 127.8 | 92.9 | 18 | 176.4 | 128.1 | 78 | 224.9 | 163.4 |
| 39 | 31.6 | 22.9 | 99 | 80.1 | 58.2 | 59 | 128.6 | 93.5 | 19 | 177.2 | 128.7 | 79 | 225.7 | 164.0 |
| 40 | 32.4 | 23.5 | 100 | 80.9 | 58.8 | 60 | 129.4 | 94.0 | 20 | 178.0 | 129.3 | 80 | 226.5 | 164.6 |
| 41 | 33.2 | 24.1 | 101 | 81.7 | 59.4 | 161 | 130.3 | 94.6 | 221 | 178.8 | 129.9 | 281 | 227.3 | 165.2 |
| 42 | 34.0 | 24.7 | 02 | 82.5 | 60.0 | 62 | 131.1 | 95.2 | 22 | 179.6 | 130.5 | 82 | 228.1 | 165.8 |
| 43 | 34.8 | 25.3 | 03 | 83.3 | 60.5 | 63 | 131.9 | 95.8 | 23 | 180.4 | 131.1 | 83 | 229.0 | 166.3 |
| 44 | 35.6 | 25.9 | 04 | 84.1 | 61.1 | 64 | 132.7 | 96.4 | 24 | 181.2 | 131.7 | 84 | 229.8 | 166.9 |
| 45 | 36.4 | 26.5 | 05 | 84.9 | 61.7 | 65 | 133.5 | 97.0 | 25 | 182.0 | 132.3 | 85 | 230.6 | 167.3 |
| 46 | 37.2 | 27.0 | 06 | 85.8 | 62.3 | 66 | 134.3 | 97.6 | 26 | 182.8 | 132.8 | 86 | 231.4 | 168.1 |
| 47 | 38.0 | 27.6 | 07 | 86.6 | 62.9 | 67 | 135.1 | 98.2 | 27 | 183.6 | 133.4 | 87 | 232.2 | 168.7 |
| 48 | 38.8 | 28.2 | 08 | 87.4 | 63.5 | 68 | 135.9 | 98.7 | 28 | 184.5 | 134.0 | 88 | 233.0 | 169.3 |
| 49 | 39.6 | 28.8 | 09 | 88.2 | 64.1 | 69 | 136.7 | 99.3 | 29 | 185.3 | 134.6 | 89 | 233.8 | 169.9 |
| 50 | 40.5 | 29.4 | 10 | 89.0 | 64.7 | 70 | 137.5 | 99.9 | 30 | 186.1 | 135.2 | 90 | 234.6 | 170.5 |
| 51 | 41.3 | 30.0 | 111 | 89.8 | 65.2 | 171 | 138.3 | 100.5 | 231 | 186.9 | 135.8 | 291 | 235.4 | 171.0 |
| 52 | 42.1 | 30.6 | 12 | 90.6 | 65.8 | 72 | 139.2 | 101.1 | 32 | 187.7 | 136.4 | 92 | 236.2 | 171.6 |
| 53 | 42.9 | 31.2 | 13 | 91.4 | 66.4 | 73 | 140.0 | 101.7 | 33 | 188.5 | 137.0 | 93 | 237.0 | 172.2 |
| 54 | 43.7 | 31.7 | 14 | 92.2 | 67.0 | 74 | 140.8 | 102.3 | 34 | 189.3 | 137.5 | 94 | 237.9 | 172.8 |
| 55 | 44.5 | 32.3 | 15 | 93.0 | 67.6 | 75 | 141.6 | 102.9 | 35 | 190.1 | 138.1 | 95 | 238.7 | 173.4 |
| 56 | 45.3 | 32.9 | 16 | 93.8 | 68.2 | 76 | 142.4 | 103.5 | 36 | 190.9 | 138.7 | 96 | 239.5 | 174.0 |
| 57 | 46.1 | 33.5 | 17 | 94.7 | 68.8 | 77 | 143.2 | 104.0 | 37 | 191.7 | 139.3 | 97 | 240.3 | 174.6 |
| 58 | 46.9 | 34.1 | 18 | 95.5 | 69.4 | 78 | 144.0 | 104.6 | 38 | 192.5 | 139.9 | 98 | 241.1 | 175.2 |
| 59 | 47.7 | 34.7 | 19 | 96.3 | 69.9 | 79 | 144.8 | 105.2 | 39 | 193.4 | 140.5 | 99 | 241.9 | 175.7 |
| 60 | 48.5 | 35.3 | 20 | 97.1 | 70.5 | 80 | 145.6 | 105.8 | 40 | 194.2 | 141.1 | 300 | 242.7 | 176.3 |

[For 54 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 37°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 48.7 | 36.7 | 121 | 96.6 | 72.8 | 181 | 144.6 | 108.9 | 241 | 192.5 | 145.0 |
| 2 | 1.6 | 1.2 | 62 | 49.5 | 37.3 | 22 | 97.4 | 73.4 | 82 | 145.4 | 109.5 | 42 | 193.3 | 145.6 |
| 3 | 2.4 | 1.8 | 63 | 50.3 | 37.9 | 23 | 98.2 | 74.0 | 83 | 146.2 | 110.1 | 43 | 194.1 | 146.2 |
| 4 | 3.2 | 2.4 | 64 | 51.1 | 38.5 | 24 | 99.0 | 74.6 | 84 | 146.9 | 110.7 | 44 | 194.9 | 146.8 |
| 5 | 4.0 | 3.0 | 65 | 51.9 | 39.1 | 25 | 99.8 | 75.2 | 85 | 147.7 | 111.3 | 45 | 195.7 | 147.4 |
| 6 | 4.8 | 3.6 | 66 | 52.7 | 39.7 | 26 | 100.6 | 75.8 | 86 | 148.5 | 111.9 | 46 | 196.5 | 148.0 |
| 7 | 5.6 | 4.2 | 67 | 53.5 | 40.3 | 27 | 101.4 | 76.4 | 87 | 149.3 | 112.5 | 47 | 197.3 | 148.6 |
| 8 | 6.4 | 4.8 | 68 | 54.3 | 40.9 | 28 | 102.2 | 77.0 | 88 | 150.1 | 113.1 | 48 | 198.1 | 149.3 |
| 9 | 7.2 | 5.4 | 69 | 55.1 | 41.5 | 29 | 103.0 | 77.6 | 89 | 150.9 | 113.7 | 49 | 198.9 | 149.9 |
| 10 | 8.0 | 6.0 | 70 | 55.9 | 42.1 | 30 | 103.8 | 78.2 | 90 | 151.7 | 114.3 | 50 | 199.7 | 150.5 |
| 11 | 8.8 | 6.6 | 71 | 56.7 | 42.7 | 131 | 104.6 | 78.8 | 191 | 152.5 | 114.9 | 251 | 200.5 | 151.1 |
| 12 | 9.6 | 7.2 | 72 | 57.5 | 43.3 | 32 | 105.4 | 79.4 | 92 | 153.3 | 115.5 | 52 | 201.3 | 151.7 |
| 13 | 10.4 | 7.8 | 73 | 58.3 | 43.9 | 33 | 106.2 | 80.0 | 93 | 154.1 | 116.2 | 53 | 202.1 | 152.3 |
| 14 | 11.2 | 8.4 | 74 | 59.1 | 44.5 | 34 | 107.0 | 80.6 | 94 | 154.9 | 116.8 | 54 | 202.9 | 152.9 |
| 15 | 12.0 | 9.0 | 75 | 59.9 | 45.1 | 35 | 107.8 | 81.2 | 95 | 155.7 | 117.4 | 55 | 203.7 | 153.5 |
| 16 | 12.8 | 9.6 | 76 | 60.7 | 45.7 | 36 | 108.6 | 81.8 | 96 | 156.5 | 118.0 | 56 | 204.5 | 154.1 |
| 17 | 13.6 | 10.2 | 77 | 61.5 | 46.3 | 37 | 109.4 | 82.4 | 97 | 157.3 | 118.6 | 57 | 205.2 | 154.7 |
| 18 | 14.4 | 10.8 | 78 | 62.3 | 46.9 | 38 | 110.2 | 83.1 | 98 | 158.1 | 119.2 | 58 | 206.0 | 155.3 |
| 19 | 15.2 | 11.4 | 79 | 63.1 | 47.5 | 39 | 111.0 | 83.7 | 99 | 158.9 | 119.8 | 59 | 206.8 | 155.9 |
| 20 | 16.0 | 12.0 | 80 | 63.9 | 48.1 | 40 | 111.8 | 84.3 | 200 | 159.7 | 120.4 | 60 | 207.6 | 156.5 |
| 21 | 16.8 | 12.6 | 81 | 64.7 | 48.7 | 141 | 112.6 | 84.9 | 201 | 160.5 | 121.0 | 261 | 208.4 | 157.1 |
| 22 | 17.6 | 13.2 | 82 | 65.5 | 49.3 | 42 | 113.4 | 85.5 | 02 | 161.3 | 121.6 | 62 | 209.2 | 157.7 |
| 23 | 18.4 | 13.8 | 83 | 66.3 | 50.0 | 43 | 114.2 | 86.1 | 03 | 162.1 | 122.2 | 63 | 210.0 | 158.3 |
| 24 | 19.2 | 14.4 | 84 | 67.1 | 50.6 | 44 | 115.0 | 86.7 | 04 | 162.9 | 122.8 | 64 | 210.8 | 158.9 |
| 25 | 20.0 | 15.0 | 85 | 67.9 | 51.2 | 45 | 115.8 | 87.3 | 05 | 163.7 | 123.4 | 65 | 211.6 | 159.5 |
| 26 | 20.8 | 15.6 | 86 | 68.7 | 51.8 | 46 | 116.6 | 87.9 | 06 | 164.5 | 124.0 | 66 | 212.4 | 160.1 |
| 27 | 21.6 | 16.2 | 87 | 69.5 | 52.4 | 47 | 117.4 | 88.5 | 07 | 165.3 | 124.6 | 67 | 213.2 | 160.7 |
| 28 | 22.4 | 16.9 | 88 | 70.3 | 53.0 | 48 | 118.2 | 89.1 | 08 | 166.1 | 125.2 | 68 | 214.0 | 161.3 |
| 29 | 23.2 | 17.5 | 89 | 71.1 | 53.6 | 49 | 119.0 | 89.7 | 09 | 166.9 | 125.8 | 69 | 214.8 | 161.9 |
| 30 | 24.0 | 18.1 | 90 | 71.9 | 54.2 | 50 | 119.8 | 90.3 | 10 | 167.7 | 126.4 | 70 | 215.6 | 162.5 |
| 31 | 24.8 | 18.7 | 91 | 72.7 | 54.8 | 151 | 120.6 | 90.9 | 211 | 168.5 | 127.0 | 271 | 216.4 | 163.1 |
| 32 | 25.6 | 19.3 | 92 | 73.5 | 55.4 | 52 | 121.4 | 91.5 | 12 | 169.3 | 127.6 | 72 | 217.2 | 163.7 |
| 33 | 26.4 | 19.9 | 93 | 74.3 | 56.0 | 53 | 122.2 | 92.1 | 13 | 170.1 | 128.2 | 73 | 218.0 | 164.3 |
| 34 | 27.2 | 20.5 | 94 | 75.1 | 56.6 | 54 | 123.0 | 92.7 | 14 | 170.9 | 128.8 | 74 | 218.8 | 164.9 |
| 35 | 28.0 | 21.1 | 95 | 75.9 | 57.2 | 55 | 123.8 | 93.3 | 15 | 171.7 | 129.4 | 75 | 219.6 | 165.5 |
| 36 | 28.8 | 21.7 | 96 | 76.7 | 57.8 | 56 | 124.6 | 93.9 | 16 | 172.5 | 130.0 | 76 | 220.4 | 166.1 |
| 37 | 29.5 | 22.3 | 97 | 77.5 | 58.4 | 57 | 125.4 | 94.5 | 17 | 173.3 | 130.6 | 77 | 221.2 | 166.7 |
| 38 | 30.3 | 22.9 | 98 | 78.3 | 59.0 | 58 | 126.2 | 95.1 | 18 | 174.1 | 131.2 | 78 | 222.0 | 167.3 |
| 39 | 31.1 | 23.5 | 99 | 79.1 | 59.6 | 59 | 127.0 | 95.7 | 19 | 174.9 | 131.8 | 79 | 222.8 | 167.9 |
| 40 | 31.9 | 24.1 | 100 | 79.9 | 60.2 | 60 | 127.8 | 96.3 | 20 | 175.7 | 132.4 | 80 | 223.6 | 168.5 |
| 41 | 32.7 | 24.7 | 101 | 80.7 | 60.8 | 161 | 128.6 | 96.9 | 221 | 176.5 | 133.0 | 281 | 224.4 | 169.1 |
| 42 | 33.5 | 25.3 | 02 | 81.5 | 61.4 | 62 | 129.4 | 97.5 | 22 | 177.3 | 133.6 | 82 | 225.2 | 169.7 |
| 43 | 34.3 | 25.9 | 03 | 82.3 | 62.0 | 63 | 130.2 | 98.1 | 23 | 178.1 | 134.2 | 83 | 226.0 | 170.3 |
| 44 | 35.1 | 26.5 | 04 | 83.1 | 62.6 | 64 | 131.0 | 98.7 | 24 | 178.9 | 134.8 | 84 | 226.8 | 170.9 |
| 45 | 35.9 | 27.1 | 05 | 83.9 | 63.2 | 65 | 131.8 | 99.3 | 25 | 179.7 | 135.4 | 85 | 227.6 | 171.5 |
| 46 | 36.7 | 27.7 | 06 | 84.7 | 63.8 | 66 | 132.6 | 99.9 | 26 | 180.5 | 136.0 | 86 | 228.4 | 172.1 |
| 47 | 37.5 | 28.3 | 07 | 85.5 | 64.4 | 67 | 133.4 | 100.5 | 27 | 181.3 | 136.6 | 87 | 229.2 | 172.7 |
| 48 | 38.3 | 28.9 | 08 | 86.3 | 65.0 | 68 | 134.2 | 101.1 | 28 | 182.1 | 137.2 | 88 | 230.0 | 173.3 |
| 49 | 39.1 | 29.5 | 09 | 87.1 | 65.6 | 69 | 135.0 | 101.7 | 29 | 182.9 | 137.8 | 89 | 230.8 | 173.9 |
| 50 | 39.9 | 30.1 | 10 | 87.9 | 66.2 | 70 | 135.8 | 102.3 | 30 | 183.7 | 138.4 | 90 | 231.6 | 174.5 |
| 51 | 40.7 | 30.7 | 111 | 88.6 | 66.8 | 171 | 136.6 | 102.9 | 231 | 184.5 | 139.0 | 291 | 232.4 | 175.1 |
| 52 | 41.5 | 31.3 | 12 | 89.4 | 67.4 | 72 | 137.4 | 103.5 | 32 | 185.3 | 139.6 | 92 | 233.2 | 175.7 |
| 53 | 42.3 | 31.9 | 13 | 90.2 | 68.0 | 73 | 138.2 | 104.1 | 33 | 186.1 | 140.2 | 93 | 234.0 | 176.3 |
| 54 | 43.1 | 32.5 | 14 | 91.0 | 68.6 | 74 | 139.0 | 104.7 | 34 | 186.9 | 140.8 | 94 | 234.8 | 176.9 |
| 55 | 43.9 | 33.1 | 15 | 91.8 | 69.2 | 75 | 139.8 | 105.3 | 35 | 187.7 | 141.4 | 95 | 235.6 | 177.5 |
| 56 | 44.7 | 33.7 | 16 | 92.6 | 69.8 | 76 | 140.6 | 105.9 | 36 | 188.5 | 142.0 | 96 | 236.4 | 178.1 |
| 57 | 45.5 | 34.3 | 17 | 93.4 | 70.4 | 77 | 141.4 | 106.5 | 37 | 189.3 | 142.6 | 97 | 237.2 | 178.7 |
| 58 | 46.3 | 34.9 | 18 | 94.2 | 71.0 | 78 | 142.2 | 107.1 | 38 | 190.1 | 143.2 | 98 | 238.0 | 179.3 |
| 59 | 47.1 | 35.5 | 19 | 95.0 | 71.6 | 79 | 143.0 | 107.7 | 39 | 190.9 | 143.8 | 99 | 238.8 | 179.9 |
| 60 | 47.9 | 36.1 | 20 | 95.8 | 72.2 | 80 | 143.8 | 108.3 | 40 | 191.7 | 144.4 | 300 | 239.6 | 180.5 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 53 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 38°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 48.1 | 37.6 | 121 | 95.3 | 74.5 | 181 | 142.6 | 111.4 | 241 | 189.9 | 148.4 |
| 2 | 1.6 | 1.2 | 62 | 48.9 | 38.2 | 22 | 96.1 | 75.1 | 82 | 143.4 | 112.1 | 42 | 190.7 | 149.0 |
| 3 | 2.4 | 1.8 | 63 | 49.6 | 38.8 | 23 | 96.9 | 75.7 | 83 | 144.2 | 112.7 | 43 | 191.5 | 149.6 |
| 4 | 3.2 | 2.5 | 64 | 50.4 | 39.4 | 24 | 97.7 | 76.3 | 84 | 145.0 | 113.3 | 44 | 192.3 | 150.2 |
| 5 | 3.9 | 3.1 | 65 | 51.2 | 40.0 | 25 | 98.5 | 77.0 | 85 | 145.8 | 113.9 | 45 | 193.1 | 150.8 |
| 6 | 4.7 | 3.7 | 66 | 52.0 | 40.6 | 26 | 99.3 | 77.6 | 86 | 146.6 | 114.5 | 46 | 193.9 | 151.5 |
| 7 | 5.5 | 4.3 | 67 | 52.8 | 41.2 | 27 | 100.1 | 78.2 | 87 | 147.4 | 115.1 | 47 | 194.6 | 152.1 |
| 8 | 6.3 | 4.9 | 68 | 53.6 | 41.9 | 28 | 100.9 | 78.8 | 88 | 148.1 | 115.7 | 48 | 195.4 | 152.7 |
| 9 | 7.1 | 5.5 | 69 | 54.4 | 42.5 | 29 | 101.7 | 79.4 | 89 | 148.9 | 116.4 | 49 | 196.2 | 153.3 |
| 10 | 7.9 | 6.2 | 70 | 55.2 | 43.1 | 30 | 102.4 | 80.0 | 90 | 149.7 | 117.0 | 50 | 197.0 | 153.9 |
| 11 | 8.7 | 6.8 | 71 | 55.9 | 43.7 | 131 | 103.2 | 80.7 | 191 | 150.5 | 117.6 | 251 | 197.8 | 154.5 |
| 12 | 9.5 | 7.4 | 72 | 56.7 | 44.3 | 32 | 104.0 | 81.3 | 92 | 151.3 | 118.2 | 52 | 198.6 | 155.1 |
| 13 | 10.2 | 8.0 | 73 | 57.5 | 44.9 | 33 | 104.8 | 81.9 | 93 | 152.1 | 118.8 | 53 | 199.4 | 155.8 |
| 14 | 11.0 | 8.6 | 74 | 58.3 | 45.6 | 34 | 105.6 | 82.5 | 94 | 152.9 | 119.4 | 54 | 200.2 | 156.4 |
| 15 | 11.8 | 9.2 | 75 | 59.1 | 46.2 | 35 | 106.4 | 83.1 | 95 | 153.7 | 120.1 | 55 | 200.9 | 157.0 |
| 16 | 12.6 | 9.9 | 76 | 59.9 | 46.8 | 36 | 107.2 | 83.7 | 96 | 154.5 | 120.7 | 56 | 201.7 | 157.6 |
| 17 | 13.4 | 10.5 | 77 | 60.7 | 47.4 | 37 | 108.0 | 84.3 | 97 | 155.2 | 121.3 | 57 | 202.5 | 158.2 |
| 18 | 14.2 | 11.1 | 78 | 61.5 | 48.0 | 38 | 108.7 | 85.0 | 98 | 156.0 | 121.9 | 58 | 203.3 | 158.8 |
| 19 | 15.0 | 11.7 | 79 | 62.3 | 48.6 | 39 | 109.5 | 85.6 | 99 | 156.8 | 122.5 | 59 | 204.1 | 159.5 |
| 20 | 15.8 | 12.3 | 80 | 63.0 | 49.3 | 40 | 110.3 | 86.2 | 200 | 157.6 | 123.1 | 60 | 204.9 | 160.1 |
| 21 | 16.5 | 12.9 | 81 | 63.8 | 49.9 | 141 | 111.1 | 86.8 | 201 | 158.4 | 123.7 | 261 | 205.7 | 160.7 |
| 22 | 17.3 | 13.5 | 82 | 64.6 | 50.5 | 42 | 111.9 | 87.4 | 02 | 159.2 | 124.4 | 62 | 206.5 | 161.3 |
| 23 | 18.1 | 14.2 | 83 | 65.4 | 51.1 | 43 | 112.7 | 88.0 | 03 | 160.0 | 125.0 | 63 | 207.2 | 161.9 |
| 24 | 18.9 | 14.8 | 84 | 66.2 | 51.7 | 44 | 113.5 | 88.7 | 04 | 160.8 | 125.6 | 64 | 208.0 | 162.5 |
| 25 | 19.7 | 15.4 | 85 | 67.0 | 52.3 | 45 | 114.3 | 89.3 | 05 | 161.5 | 126.2 | 65 | 208.8 | 163.2 |
| 26 | 20.5 | 16.0 | 86 | 67.8 | 52.9 | 46 | 115.0 | 89.9 | 06 | 162.3 | 126.8 | 66 | 209.6 | 163.8 |
| 27 | 21.3 | 16.6 | 87 | 68.6 | 53.6 | 47 | 115.8 | 90.5 | 07 | 163.1 | 127.4 | 67 | 210.4 | 164.4 |
| 28 | 22.1 | 17.2 | 88 | 69.3 | 54.2 | 48 | 116.6 | 91.1 | 08 | 163.9 | 128.1 | 68 | 211.2 | 165.0 |
| 29 | 22.9 | 17.9 | 89 | 70.1 | 54.8 | 49 | 117.4 | 91.7 | 09 | 164.7 | 128.7 | 69 | 212.0 | 165.6 |
| 30 | 23.6 | 18.5 | 90 | 70.9 | 55.4 | 50 | 118.2 | 92.3 | 10 | 165.5 | 129.3 | 70 | 212.8 | 166.2 |
| 31 | 24.4 | 19.1 | 91 | 71.7 | 56.0 | 151 | 119.0 | 93.0 | 211 | 166.3 | 129.9 | 271 | 213.6 | 166.8 |
| 32 | 25.2 | 19.7 | 92 | 72.5 | 56.6 | 52 | 119.8 | 93.6 | 12 | 167.1 | 130.5 | 72 | 214.4 | 167.5 |
| 33 | 26.0 | 20.3 | 93 | 73.3 | 57.3 | 53 | 120.6 | 94.2 | 13 | 167.8 | 131.1 | 73 | 215.1 | 168.1 |
| 34 | 26.8 | 20.9 | 94 | 74.1 | 57.9 | 54 | 121.4 | 94.8 | 14 | 168.6 | 131.8 | 74 | 215.9 | 168.7 |
| 35 | 27.6 | 21.5 | 95 | 74.9 | 58.5 | 55 | 122.1 | 95.4 | 15 | 169.4 | 132.4 | 75 | 216.7 | 169.3 |
| 36 | 28.4 | 22.2 | 96 | 75.7 | 59.1 | 56 | 122.9 | 96.0 | 16 | 170.2 | 133.0 | 76 | 217.5 | 169.9 |
| 37 | 29.2 | 22.8 | 97 | 76.4 | 59.7 | 57 | 123.7 | 96.7 | 17 | 171.0 | 133.6 | 77 | 218.3 | 170.5 |
| 38 | 29.9 | 23.4 | 98 | 77.2 | 60.3 | 58 | 124.5 | 97.3 | 18 | 171.8 | 134.2 | 78 | 219.1 | 171.2 |
| 39 | 30.7 | 24.0 | 99 | 78.0 | 61.0 | 59 | 125.3 | 97.9 | 19 | 172.6 | 134.8 | 79 | 219.9 | 171.8 |
| 40 | 31.5 | 24.6 | 100 | 78.8 | 61.6 | 60 | 126.1 | 98.5 | 20 | 173.4 | 135.4 | 80 | 220.6 | 172.4 |
| 41 | 32.3 | 25.2 | 101 | 79.6 | 62.2 | 161 | 126.9 | 99.1 | 221 | 174.2 | 136.1 | 281 | 221.4 | 173.0 |
| 42 | 33.1 | 25.9 | 02 | 80.4 | 62.8 | 62 | 127.7 | 99.7 | 22 | 174.9 | 136.7 | 82 | 222.2 | 173.6 |
| 43 | 33.9 | 26.5 | 03 | 81.2 | 63.4 | 63 | 128.4 | 100.4 | 23 | 175.7 | 137.3 | 83 | 223.0 | 174.2 |
| 44 | 34.7 | 27.1 | 04 | 82.0 | 64.0 | 64 | 129.2 | 101.0 | 24 | 176.5 | 137.9 | 84 | 223.8 | 174.8 |
| 45 | 35.5 | 27.7 | 05 | 82.7 | 64.6 | 65 | 130.0 | 101.6 | 25 | 177.3 | 138.5 | 85 | 224.6 | 175.5 |
| 46 | 36.2 | 28.3 | 06 | 83.5 | 65.3 | 66 | 130.8 | 102.2 | 26 | 178.1 | 139.1 | 86 | 225.4 | 176.1 |
| 47 | 37.0 | 28.9 | 07 | 84.3 | 65.9 | 67 | 131.6 | 102.8 | 27 | 178.9 | 139.8 | 87 | 226.2 | 176.7 |
| 48 | 37.8 | 29.6 | 08 | 85.1 | 66.5 | 68 | 132.4 | 103.4 | 28 | 179.7 | 140.4 | 88 | 226.9 | 177.3 |
| 49 | 38.6 | 30.2 | 09 | 85.9 | 67.1 | 69 | 133.2 | 104.0 | 29 | 180.5 | 141.0 | 89 | 227.7 | 177.9 |
| 50 | 39.4 | 30.8 | 10 | 86.7 | 67.7 | 70 | 134.0 | 104.7 | 30 | 181.2 | 141.6 | 90 | 228.5 | 178.5 |
| 51 | 40.2 | 31.4 | 111 | 87.5 | 68.3 | 171 | 134.7 | 105.3 | 231 | 182.0 | 142.2 | 291 | 229.3 | 179.2 |
| 52 | 41.0 | 32.0 | 12 | 88.3 | 69.0 | 72 | 135.5 | 105.9 | 32 | 182.8 | 142.8 | 92 | 230.1 | 179.8 |
| 53 | 41.8 | 32.6 | 13 | 89.0 | 69.6 | 73 | 136.3 | 106.5 | 33 | 183.6 | 143.4 | 93 | 230.9 | 180.4 |
| 54 | 42.6 | 33.2 | 14 | 89.8 | 70.2 | 74 | 137.1 | 107.1 | 34 | 184.4 | 144.1 | 94 | 231.7 | 181.0 |
| 55 | 43.3 | 33.9 | 15 | 90.6 | 70.8 | 75 | 137.9 | 107.7 | 35 | 185.2 | 144.7 | 95 | 232.5 | 181.6 |
| 56 | 44.1 | 34.5 | 16 | 91.4 | 71.4 | 76 | 138.7 | 108.4 | 36 | 186.0 | 145.3 | 96 | 233.3 | 182.2 |
| 57 | 44.9 | 35.1 | 17 | 92.2 | 72.0 | 77 | 139.5 | 109.0 | 37 | 186.8 | 145.9 | 97 | 234.0 | 182.9 |
| 58 | 45.7 | 35.7 | 18 | 93.0 | 72.6 | 78 | 140.3 | 109.6 | 38 | 187.5 | 146.5 | 98 | 234.8 | 183.5 |
| 59 | 46.5 | 36.3 | 19 | 93.8 | 73.3 | 79 | 141.1 | 110.2 | 39 | 188.3 | 147.1 | 99 | 235.6 | 184.1 |
| 60 | 47.3 | 36.9 | 20 | 94.6 | 73.9 | 80 | 141.8 | 110.8 | 40 | 189.1 | 147.8 | 300 | 236.4 | 184.7 |

[For 52 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 39°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 47.4 | 38.4 | 121 | 94.0 | 76.1 | 181 | 140.7 | 113.9 | 241 | 187.3 | 151.7 |
| 2 | 1.6 | 1.3 | 62 | 48.2 | 39.0 | 22 | 94.8 | 76.8 | 82 | 141.4 | 114.5 | 42 | 188.1 | 152.3 |
| 3 | 2.3 | 1.9 | 63 | 49.0 | 39.6 | 23 | 95.6 | 77.4 | 83 | 142.2 | 115.2 | 43 | 188.8 | 152.9 |
| 4 | 3.1 | 2.5 | 64 | 49.7 | 40.3 | 24 | 96.4 | 78.0 | 84 | 143.0 | 115.8 | 44 | 189.6 | 153.6 |
| 5 | 3.9 | 3.1 | 65 | 50.5 | 40.9 | 25 | 97.1 | 78.7 | 85 | 143.8 | 116.4 | 45 | 190.4 | 154.2 |
| 6 | 4.7 | 3.8 | 66 | 51.3 | 41.5 | 26 | 97.9 | 79.3 | 86 | 144.5 | 117.1 | 46 | 191.2 | 154.8 |
| 7 | 5.4 | 4.4 | 67 | 52.1 | 42.2 | 27 | 98.7 | 79.9 | 87 | 145.3 | 117.7 | 47 | 192.0 | 155.4 |
| 8 | 6.2 | 5.0 | 68 | 52.8 | 42.8 | 28 | 99.5 | 80.6 | 88 | 146.1 | 118.3 | 48 | 192.7 | 156.1 |
| 9 | 7.0 | 5.7 | 69 | 53.6 | 43.4 | 29 | 100.3 | 81.2 | 89 | 146.9 | 118.9 | 49 | 193.5 | 156.7 |
| 10 | 7.8 | 6.3 | 70 | 54.4 | 44.1 | 30 | 101.0 | 81.8 | 90 | 147.7 | 119.6 | 50 | 194.3 | 157.3 |
| 11 | 8.5 | 6.9 | 71 | 55.2 | 44.7 | 131 | 101.8 | 82.4 | 191 | 148.4 | 120.2 | 251 | 195.1 | 158.0 |
| 12 | 9.3 | 7.6 | 72 | 56.0 | 45.3 | 32 | 102.6 | 83.1 | 92 | 149.2 | 120.8 | 52 | 195.8 | 158.6 |
| 13 | 10.1 | 8.2 | 73 | 56.7 | 45.9 | 33 | 103.4 | 83.7 | 93 | 150.0 | 121.5 | 53 | 196.6 | 159.2 |
| 14 | 10.9 | 8.8 | 74 | 57.5 | 46.6 | 34 | 104.1 | 84.3 | 94 | 150.8 | 122.1 | 54 | 197.4 | 159.8 |
| 15 | 11.7 | 9.4 | 75 | 58.3 | 47.2 | 35 | 104.9 | 85.0 | 95 | 151.5 | 122.7 | 55 | 198.2 | 160.5 |
| 16 | 12.4 | 10.1 | 76 | 59.1 | 47.8 | 36 | 105.7 | 85.6 | 96 | 152.3 | 123.3 | 56 | 199.0 | 161.1 |
| 17 | 13.2 | 10.7 | 77 | 59.8 | 48.5 | 37 | 106.5 | 86.2 | 97 | 153.1 | 124.0 | 57 | 199.7 | 161.7 |
| 18 | 14.0 | 11.3 | 78 | 60.6 | 49.1 | 38 | 107.2 | 86.8 | 98 | 153.9 | 124.6 | 58 | 200.5 | 162.4 |
| 19 | 14.8 | 12.0 | 79 | 61.4 | 49.7 | 39 | 108.0 | 87.5 | 99 | 154.7 | 125.2 | 59 | 201.3 | 163.0 |
| 20 | 15.5 | 12.6 | 80 | 62.2 | 50.3 | 40 | 108.8 | 88.1 | 200 | 155.4 | 125.9 | 60 | 202.1 | 163.6 |
| 21 | 16.3 | 13.2 | 81 | 62.9 | 51.0 | 141 | 109.6 | 88.7 | 201 | 156.2 | 126.5 | 261 | 202.8 | 164.3 |
| 22 | 17.1 | 13.8 | 82 | 63.7 | 51.6 | 42 | 110.4 | 89.4 | 02 | 157.0 | 127.1 | 62 | 203.6 | 164.9 |
| 23 | 17.9 | 14.5 | 83 | 64.5 | 52.2 | 43 | 111.1 | 90.0 | 03 | 157.8 | 127.8 | 63 | 204.4 | 165.5 |
| 24 | 18.7 | 15.1 | 84 | 65.3 | 52.9 | 44 | 111.9 | 90.6 | 04 | 158.5 | 128.4 | 64 | 205.2 | 166.1 |
| 25 | 19.4 | 15.7 | 85 | 66.1 | 53.5 | 45 | 112.7 | 91.3 | 05 | 159.3 | 129.0 | 65 | 206.0 | 166.8 |
| 26 | 20.2 | 16.4 | 86 | 66.8 | 54.1 | 46 | 113.5 | 91.9 | 06 | 160.1 | 129.6 | 66 | 206.7 | 167.4 |
| 27 | 21.0 | 17.0 | 87 | 67.6 | 54.8 | 47 | 114.2 | 92.5 | 07 | 160.9 | 130.3 | 67 | 207.5 | 168.0 |
| 28 | 21.8 | 17.6 | 88 | 68.4 | 55.4 | 48 | 115.0 | 93.1 | 08 | 161.6 | 130.9 | 68 | 208.3 | 168.7 |
| 29 | 22.5 | 18.3 | 89 | 69.2 | 56.0 | 49 | 115.8 | 93.8 | 09 | 162.4 | 131.5 | 69 | 209.1 | 169.3 |
| 30 | 23.3 | 18.9 | 90 | 69.9 | 56.6 | 50 | 116.6 | 94.4 | 10 | 163.2 | 132.2 | 70 | 209.8 | 169.9 |
| 31 | 24.1 | 19.5 | 91 | 70.7 | 57.3 | 151 | 117.3 | 95.0 | 211 | 164.0 | 132.8 | 271 | 210.6 | 170.5 |
| 32 | 24.9 | 20.1 | 92 | 71.5 | 57.9 | 52 | 118.1 | 95.7 | 12 | 164.8 | 133.4 | 72 | 211.4 | 171.2 |
| 33 | 25.6 | 20.8 | 93 | 72.3 | 58.5 | 53 | 118.9 | 96.3 | 13 | 165.5 | 134.0 | 73 | 212.2 | 171.8 |
| 34 | 26.4 | 21.4 | 94 | 73.1 | 59.2 | 54 | 119.7 | 96.9 | 14 | 166.3 | 134.7 | 74 | 213.0 | 172.4 |
| 35 | 27.2 | 22.0 | 95 | 73.8 | 59.8 | 55 | 120.5 | 97.5 | 15 | 167.1 | 135.3 | 75 | 213.7 | 173.1 |
| 36 | 28.0 | 22.7 | 96 | 74.6 | 60.4 | 56 | 121.2 | 98.2 | 16 | 167.9 | 135.9 | 76 | 214.5 | 173.7 |
| 37 | 28.8 | 23.3 | 97 | 75.4 | 61.0 | 57 | 122.0 | 98.8 | 17 | 168.6 | 136.6 | 77 | 215.3 | 174.3 |
| 38 | 29.5 | 23.9 | 98 | 76.2 | 61.7 | 58 | 122.8 | 99.4 | 18 | 169.4 | 137.2 | 78 | 216.0 | 175.0 |
| 39 | 30.3 | 24.5 | 99 | 76.9 | 62.3 | 59 | 123.6 | 100.1 | 19 | 170.2 | 137.8 | 79 | 216.8 | 175.6 |
| 40 | 31.1 | 25.2 | 100 | 77.7 | 62.9 | 60 | 124.3 | 100.7 | 20 | 171.0 | 138.5 | 80 | 217.6 | 176.2 |
| 41 | 31.9 | 25.8 | 101 | 78.5 | 63.6 | 161 | 125.1 | 101.3 | 221 | 171.7 | 139.1 | 281 | 218.4 | 176.8 |
| 42 | 32.6 | 26.4 | 02 | 79.3 | 64.2 | 62 | 125.9 | 101.9 | 22 | 172.5 | 139.7 | 82 | 219.2 | 177.5 |
| 43 | 33.4 | 27.1 | 03 | 80.0 | 64.8 | 63 | 126.7 | 102.6 | 23 | 173.3 | 140.3 | 83 | 219.9 | 178.1 |
| 44 | 34.2 | 27.7 | 04 | 80.8 | 65.4 | 64 | 127.5 | 103.2 | 24 | 174.1 | 141.0 | 84 | 220.7 | 178.7 |
| 45 | 35.0 | 28.3 | 05 | 81.6 | 66.1 | 65 | 128.2 | 103.8 | 25 | 174.9 | 141.6 | 85 | 221.5 | 179.4 |
| 46 | 35.7 | 28.9 | 06 | 82.4 | 66.7 | 66 | 129.0 | 104.5 | 26 | 175.6 | 142.2 | 86 | 222.3 | 180.0 |
| 47 | 36.5 | 29.6 | 07 | 83.2 | 67.3 | 67 | 129.8 | 105.1 | 27 | 176.4 | 142.9 | 87 | 223.0 | 180.6 |
| 48 | 37.3 | 30.2 | 08 | 83.9 | 68.0 | 68 | 130.6 | 105.7 | 28 | 177.2 | 143.5 | 88 | 223.8 | 181.2 |
| 49 | 38.1 | 30.8 | 09 | 84.7 | 68.6 | 69 | 131.3 | 106.4 | 29 | 178.0 | 144.1 | 89 | 224.6 | 181.9 |
| 50 | 38.9 | 31.5 | 10 | 85.5 | 69.2 | 70 | 132.1 | 107.0 | 30 | 178.7 | 144.7 | 90 | 225.4 | 182.5 |
| 51 | 39.6 | 32.1 | 111 | 86.3 | 69.9 | 171 | 132.9 | 107.6 | 231 | 179.5 | 145.4 | 291 | 226.1 | 183.1 |
| 52 | 40.4 | 32.7 | 12 | 87.0 | 70.5 | 72 | 133.7 | 108.2 | 32 | 180.3 | 146.0 | 92 | 226.9 | 183.8 |
| 53 | 41.2 | 33.4 | 13 | 87.8 | 71.1 | 73 | 134.4 | 108.9 | 33 | 181.1 | 146.6 | 93 | 227.7 | 184.4 |
| 54 | 42.0 | 34.0 | 14 | 88.6 | 71.7 | 74 | 135.2 | 109.5 | 34 | 181.9 | 147.3 | 94 | 228.5 | 185.0 |
| 55 | 42.7 | 34.6 | 15 | 89.4 | 72.4 | 75 | 136.0 | 110.1 | 35 | 182.6 | 147.9 | 95 | 229.3 | 185.6 |
| 56 | 43.5 | 35.2 | 16 | 90.1 | 73.0 | 76 | 136.8 | 110.8 | 36 | 183.4 | 148.5 | 96 | 230.0 | 186.3 |
| 57 | 44.3 | 35.9 | 17 | 90.9 | 73.6 | 77 | 137.6 | 111.4 | 37 | 184.2 | 149.1 | 97 | 230.8 | 186.9 |
| 58 | 45.1 | 36.5 | 18 | 91.7 | 74.3 | 78 | 138.3 | 112.0 | 38 | 185.0 | 149.8 | 98 | 231.6 | 187.5 |
| 59 | 45.9 | 37.1 | 19 | 92.5 | 74.9 | 79 | 139.1 | 112.6 | 39 | 185.7 | 150.4 | 99 | 232.4 | 188.2 |
| 60 | 46.6 | 37.8 | 20 | 93.3 | 75.5 | 80 | 139.9 | 113.3 | 40 | 186.5 | 151.0 | 300 | 233.1 | 188.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 51 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 40°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.6 | 61 | 46.7 | 39.2 | 121 | 92.7 | 77.8 | 181 | 138.7 | 116.3 | 241 | 184.6 | 154.9 |
| 2 | 1.5 | 1.3 | 62 | 47.5 | 39.9 | 22 | 93.5 | 78.4 | 82 | 139.4 | 117.0 | 42 | 185.4 | 155.6 |
| 3 | 2.3 | 1.9 | 63 | 48.3 | 40.5 | 23 | 94.2 | 79.1 | 83 | 140.2 | 117.6 | 43 | 186.1 | 156.2 |
| 4 | 3.1 | 2.6 | 64 | 49.0 | 41.1 | 24 | 95.0 | 79.7 | 84 | 141.0 | 118.3 | 44 | 186.9 | 156.8 |
| 5 | 3.8 | 3.2 | 65 | 49.8 | 41.8 | 25 | 95.8 | 80.3 | 85 | 141.7 | 118.9 | 45 | 187.7 | 157.5 |
| 6 | 4.6 | 3.9 | 66 | 50.6 | 42.4 | 26 | 96.5 | 81.0 | 86 | 142.5 | 119.6 | 46 | 188.4 | 158.1 |
| 7 | 5.4 | 4.5 | 67 | 51.3 | 43.1 | 27 | 97.3 | 81.6 | 87 | 143.3 | 120.2 | 47 | 189.2 | 158.8 |
| 8 | 6.1 | 5.1 | 68 | 52.1 | 43.7 | 28 | 98.1 | 82.3 | 88 | 144.0 | 120.8 | 48 | 190.0 | 159.4 |
| 9 | 6.9 | 5.8 | 69 | 52.9 | 44.4 | 29 | 98.8 | 82.9 | 89 | 144.8 | 121.5 | 49 | 190.7 | 160.1 |
| 10 | 7.7 | 6.4 | 70 | 53.6 | 45.0 | 30 | 99.6 | 83.6 | 90 | 145.5 | 122.1 | 50 | 191.5 | 160.7 |
| 11 | 8.4 | 7.1 | 71 | 54.4 | 45.6 | 131 | 100.4 | 84.2 | 191 | 146.3 | 122.8 | 251 | 192.3 | 161.3 |
| 12 | 9.2 | 7.7 | 72 | 55.2 | 46.3 | 32 | 101.1 | 84.8 | 92 | 147.1 | 123.4 | 52 | 193.0 | 162.0 |
| 13 | 10.0 | 8.4 | 73 | 55.9 | 46.9 | 33 | 101.9 | 85.5 | 93 | 147.8 | 124.1 | 53 | 193.8 | 162.6 |
| 14 | 10.7 | 9.0 | 74 | 56.7 | 47.6 | 34 | 102.6 | 86.1 | 94 | 148.6 | 124.7 | 54 | 194.6 | 163.3 |
| 15 | 11.5 | 9.6 | 75 | 57.5 | 48.2 | 35 | 103.4 | 86.8 | 95 | 149.4 | 125.3 | 55 | 195.3 | 163.9 |
| 16 | 12.3 | 10.3 | 76 | 58.2 | 48.9 | 36 | 104.2 | 87.4 | 96 | 150.1 | 126.0 | 56 | 196.1 | 164.6 |
| 17 | 13.0 | 10.9 | 77 | 59.0 | 49.5 | 37 | 104.9 | 88.1 | 97 | 150.9 | 126.6 | 57 | 196.9 | 165.2 |
| 18 | 13.8 | 11.6 | 78 | 59.8 | 50.1 | 38 | 105.7 | 88.7 | 98 | 151.7 | 127.3 | 58 | 197.6 | 165.8 |
| 19 | 14.6 | 12.2 | 79 | 60.5 | 50.8 | 39 | 106.5 | 89.3 | 99 | 152.4 | 127.9 | 59 | 198.4 | 166.5 |
| 20 | 15.3 | 12.9 | 80 | 61.3 | 51.4 | 40 | 107.2 | 90.0 | 200 | 153.2 | 128.6 | 60 | 199.2 | 167.1 |
| 21 | 16.1 | 13.5 | 81 | 62.0 | 52.1 | 141 | 108.0 | 90.6 | 201 | 154.0 | 129.2 | 261 | 199.9 | 167.8 |
| 22 | 16.9 | 14.1 | 82 | 62.8 | 52.7 | 42 | 108.8 | 91.3 | 02 | 154.7 | 129.8 | 62 | 200.7 | 168.4 |
| 23 | 17.6 | 14.8 | 83 | 63.6 | 53.4 | 43 | 109.5 | 91.9 | 03 | 155.5 | 130.5 | 63 | 201.5 | 169.1 |
| 24 | 18.4 | 15.4 | 84 | 64.3 | 54.0 | 44 | 110.3 | 92.6 | 04 | 156.3 | 131.1 | 64 | 202.2 | 169.7 |
| 25 | 19.2 | 16.1 | 85 | 65.1 | 54.6 | 45 | 111.1 | 93.2 | 05 | 157.0 | 131.8 | 65 | 203.0 | 170.3 |
| 26 | 19.9 | 16.7 | 86 | 65.9 | 55.3 | 46 | 111.8 | 93.8 | 06 | 157.8 | 132.4 | 66 | 203.8 | 171.0 |
| 27 | 20.7 | 17.4 | 87 | 66.6 | 55.9 | 47 | 112.6 | 94.5 | 07 | 158.6 | 133.1 | 67 | 204.5 | 171.6 |
| 28 | 21.4 | 18.0 | 88 | 67.4 | 56.6 | 48 | 113.4 | 95.1 | 08 | 159.3 | 133.7 | 68 | 205.3 | 172.3 |
| 29 | 22.2 | 18.6 | 89 | 68.2 | 57.2 | 49 | 114.1 | 95.8 | 09 | 160.1 | 134.3 | 69 | 206.1 | 172.9 |
| 30 | 23.0 | 19.3 | 90 | 68.9 | 57.9 | 50 | 114.9 | 96.4 | 10 | 160.9 | 135.0 | 70 | 206.8 | 173.6 |
| 31 | 23.7 | 19.9 | 91 | 69.7 | 58.5 | 151 | 115.7 | 97.1 | 211 | 161.6 | 135.6 | 271 | 207.6 | 174.2 |
| 32 | 24.5 | 20.6 | 92 | 70.5 | 59.1 | 52 | 116.4 | 97.7 | 12 | 162.4 | 136.3 | 72 | 208.4 | 174.8 |
| 33 | 25.3 | 21.2 | 93 | 71.2 | 59.8 | 53 | 117.2 | 98.3 | 13 | 163.2 | 136.9 | 73 | 209.1 | 175.5 |
| 34 | 26.0 | 21.9 | 94 | 72.0 | 60.4 | 54 | 118.0 | 99.0 | 14 | 163.9 | 137.6 | 74 | 209.9 | 176.1 |
| 35 | 26.8 | 22.5 | 95 | 72.8 | 61.1 | 55 | 118.7 | 99.6 | 15 | 164.7 | 138.2 | 75 | 210.7 | 176.8 |
| 36 | 27.6 | 23.1 | 96 | 73.5 | 61.7 | 56 | 119.5 | 100.3 | 16 | 165.5 | 138.8 | 76 | 211.4 | 177.4 |
| 37 | 28.3 | 23.8 | 97 | 74.3 | 62.4 | 57 | 120.3 | 100.9 | 17 | 166.2 | 139.5 | 77 | 212.2 | 178.1 |
| 38 | 29.1 | 24.4 | 98 | 75.1 | 63.0 | 58 | 121.0 | 101.6 | 18 | 167.0 | 140.1 | 78 | 213.0 | 178.7 |
| 39 | 29.9 | 25.1 | 99 | 75.8 | 63.6 | 59 | 121.8 | 102.2 | 19 | 167.8 | 140.8 | 79 | 213.7 | 179.3 |
| 40 | 30.6 | 25.7 | 100 | 76.6 | 64.3 | 60 | 122.6 | 102.8 | 20 | 168.5 | 141.4 | 80 | 214.5 | 180.0 |
| 41 | 31.4 | 26.4 | 101 | 77.4 | 64.9 | 161 | 123.3 | 103.5 | 221 | 169.3 | 142.1 | 281 | 215.3 | 180.6 |
| 42 | 32.2 | 27.0 | 02 | 78.1 | 65.6 | 62 | 124.1 | 104.1 | 22 | 170.1 | 142.7 | 82 | 216.0 | 181.3 |
| 43 | 32.9 | 27.6 | 03 | 78.9 | 66.2 | 63 | 124.9 | 104.8 | 23 | 170.8 | 143.3 | 83 | 216.8 | 181.9 |
| 44 | 33.7 | 28.3 | 04 | 79.7 | 66.8 | 64 | 125.6 | 105.4 | 24 | 171.6 | 144.0 | 84 | 217.6 | 182.6 |
| 45 | 34.5 | 28.9 | 05 | 80.4 | 67.5 | 65 | 126.4 | 106.1 | 25 | 172.4 | 144.6 | 85 | 218.3 | 183.2 |
| 46 | 35.2 | 29.6 | 06 | 81.2 | 68.1 | 66 | 127.2 | 106.7 | 26 | 173.1 | 145.3 | 86 | 219.1 | 183.8 |
| 47 | 36.0 | 30.2 | 07 | 82.0 | 68.8 | 67 | 127.9 | 107.3 | 27 | 173.9 | 145.9 | 87 | 219.9 | 184.5 |
| 48 | 36.8 | 30.9 | 08 | 82.7 | 69.4 | 68 | 128.7 | 108.0 | 28 | 174.7 | 146.6 | 88 | 220.6 | 185.1 |
| 49 | 37.5 | 31.5 | 09 | 83.5 | 70.1 | 69 | 129.5 | 108.6 | 29 | 175.4 | 147.2 | 89 | 221.4 | 185.8 |
| 50 | 38.3 | 32.1 | 10 | 84.3 | 70.7 | 70 | 130.2 | 109.3 | 30 | 176.2 | 147.8 | 90 | 222.2 | 186.4 |
| 51 | 39.1 | 32.8 | 111 | 85.0 | 71.3 | 171 | 131.0 | 109.9 | 231 | 177.0 | 148.5 | 291 | 222.9 | 187.1 |
| 52 | 39.8 | 33.4 | 12 | 85.8 | 72.0 | 72 | 131.8 | 110.6 | 32 | 177.7 | 149.1 | 92 | 223.7 | 187.7 |
| 53 | 40.6 | 34.1 | 13 | 86.6 | 72.6 | 73 | 132.5 | 111.2 | 33 | 178.5 | 149.8 | 93 | 224.5 | 188.3 |
| 54 | 41.4 | 34.7 | 14 | 87.3 | 73.3 | 74 | 133.3 | 111.8 | 34 | 179.3 | 150.4 | 94 | 225.2 | 189.0 |
| 55 | 42.1 | 35.4 | 15 | 88.1 | 73.9 | 75 | 134.1 | 112.5 | 35 | 180.0 | 151.1 | 95 | 226.0 | 189.6 |
| 56 | 42.9 | 36.0 | 16 | 88.9 | 74.6 | 76 | 134.8 | 113.1 | 36 | 180.8 | 151.7 | 96 | 226.7 | 190.3 |
| 57 | 43.7 | 36.6 | 17 | 89.6 | 75.2 | 77 | 135.6 | 113.8 | 37 | 181.6 | 152.3 | 97 | 227.5 | 190.9 |
| 58 | 44.4 | 37.3 | 18 | 90.4 | 75.8 | 78 | 136.4 | 114.4 | 38 | 182.3 | 153.0 | 98 | 228.3 | 191.6 |
| 59 | 45.2 | 37.9 | 19 | 91.2 | 76.5 | 79 | 137.1 | 115.1 | 39 | 183.1 | 153.6 | 99 | 229.0 | 192.2 |
| 60 | 46.0 | 38.6 | 20 | 91.9 | 77.1 | 80 | 137.9 | 115.7 | 40 | 183.9 | 154.3 | 300 | 229.8 | 192.8 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 50 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 41°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.8 | 0.7 | 61 | 46.0 | 40.0 | 121 | 91.3 | 79.4 | 181 | 136.6 | 118.7 | 241 | 181.9 | 158.8 |
| 2 | 1.5 | 1.3 | 62 | 46.8 | 40.7 | 22 | 92.1 | 80.0 | 82 | 137.4 | 119.4 | 42 | 182.6 | 158.8 |
| 3 | 2.3 | 2.0 | 63 | 47.5 | 41.3 | 23 | 92.8 | 80.7 | 83 | 138.1 | 120.1 | 43 | 183.4 | 159.4 |
| 4 | 3.0 | 2.6 | 64 | 48.3 | 42.0 | 24 | 93.6 | 81.4 | 84 | 138.9 | 120.7 | 44 | 184.1 | 160.1 |
| 5 | 3.8 | 3.3 | 65 | 49.1 | 42.6 | 25 | 94.3 | 82.0 | 85 | 139.6 | 121.4 | 45 | 184.9 | 160.7 |
| 6 | 4.5 | 3.9 | 66 | 49.8 | 43.3 | 26 | 95.1 | 82.7 | 86 | 140.4 | 122.0 | 46 | 185.7 | 161.4 |
| 7 | 5.3 | 4.6 | 67 | 50.6 | 44.0 | 27 | 95.8 | 83.3 | 87 | 141.1 | 122.7 | 47 | 186.4 | 162.0 |
| 8 | 6.0 | 5.2 | 68 | 51.3 | 44.6 | 28 | 96.6 | 84.0 | 88 | 141.9 | 123.3 | 48 | 187.2 | 162.7 |
| 9 | 6.8 | 5.9 | 69 | 52.1 | 45.3 | 29 | 97.4 | 84.6 | 89 | 142.6 | 124.0 | 49 | 187.9 | 163.4 |
| 10 | 7.5 | 6.6 | 70 | 52.8 | 45.9 | 30 | 98.1 | 85.3 | 90 | 143.4 | 124.7 | 50 | 188.7 | 164.0 |
| 11 | 8.3 | 7.2 | 71 | 53.6 | 46.6 | 31 | 98.9 | 85.9 | 91 | 144.1 | 125.3 | 51 | 189.4 | 164.7 |
| 12 | 9.1 | 7.9 | 72 | 54.3 | 47.2 | 32 | 99.6 | 86.6 | 92 | 144.9 | 126.0 | 52 | 190.2 | 165.3 |
| 13 | 9.8 | 8.5 | 73 | 55.1 | 47.9 | 33 | 100.4 | 87.3 | 93 | 145.7 | 126.6 | 53 | 190.9 | 166.0 |
| 14 | 10.6 | 9.2 | 74 | 55.8 | 48.5 | 34 | 101.1 | 87.9 | 94 | 146.4 | 127.3 | 54 | 191.7 | 166.6 |
| 15 | 11.3 | 9.8 | 75 | 56.6 | 49.2 | 35 | 101.9 | 88.6 | 95 | 147.2 | 127.9 | 55 | 192.5 | 167.3 |
| 16 | 12.1 | 10.5 | 76 | 57.4 | 49.9 | 36 | 102.6 | 89.2 | 96 | 147.9 | 128.6 | 56 | 193.2 | 168.0 |
| 17 | 12.8 | 11.2 | 77 | 58.1 | 50.5 | 37 | 103.4 | 89.9 | 97 | 148.7 | 129.2 | 57 | 194.0 | 168.6 |
| 18 | 13.6 | 11.8 | 78 | 58.9 | 51.2 | 38 | 104.1 | 90.5 | 98 | 149.4 | 129.9 | 58 | 194.7 | 169.3 |
| 19 | 14.3 | 12.5 | 79 | 59.6 | 51.8 | 39 | 104.9 | 91.2 | 99 | 150.2 | 130.6 | 59 | 195.5 | 169.9 |
| 20 | 15.1 | 13.1 | 80 | 60.4 | 52.5 | 40 | 105.7 | 91.8 | 200 | 150.9 | 131.2 | 60 | 196.2 | 170.6 |
| 21 | 15.8 | 13.8 | 81 | 61.1 | 53.1 | 41 | 106.4 | 92.5 | 201 | 151.7 | 131.9 | 61 | 197.0 | 171.2 |
| 22 | 16.6 | 14.4 | 82 | 61.9 | 53.8 | 42 | 107.2 | 93.2 | 02 | 152.5 | 132.5 | 62 | 197.7 | 171.9 |
| 23 | 17.4 | 15.1 | 83 | 62.6 | 54.5 | 43 | 107.9 | 93.8 | 03 | 153.2 | 133.2 | 63 | 198.5 | 172.5 |
| 24 | 18.1 | 15.7 | 84 | 63.4 | 55.1 | 44 | 108.7 | 94.5 | 04 | 154.0 | 133.8 | 64 | 199.2 | 173.2 |
| 25 | 18.9 | 16.4 | 85 | 64.2 | 55.8 | 45 | 109.4 | 95.1 | 05 | 154.7 | 134.5 | 65 | 200.0 | 173.9 |
| 26 | 19.6 | 17.1 | 86 | 64.9 | 56.4 | 46 | 110.2 | 95.8 | 06 | 155.5 | 135.1 | 66 | 200.8 | 174.5 |
| 27 | 20.4 | 17.7 | 87 | 65.7 | 57.1 | 47 | 110.9 | 96.4 | 07 | 156.2 | 135.8 | 67 | 201.5 | 175.2 |
| 28 | 21.1 | 18.4 | 88 | 66.4 | 57.7 | 48 | 111.7 | 97.1 | 08 | 157.0 | 136.5 | 68 | 202.3 | 175.8 |
| 29 | 21.9 | 19.0 | 89 | 67.2 | 58.4 | 49 | 112.5 | 97.8 | 09 | 157.7 | 137.1 | 69 | 203.0 | 176.5 |
| 30 | 22.6 | 19.7 | 90 | 67.9 | 59.0 | 50 | 113.2 | 98.4 | 10 | 158.5 | 137.8 | 70 | 203.8 | 177.1 |
| 31 | 23.4 | 20.3 | 91 | 68.7 | 59.7 | 51 | 114.0 | 99.1 | 211 | 159.2 | 138.4 | 271 | 204.5 | 177.8 |
| 32 | 24.2 | 21.0 | 92 | 69.4 | 60.4 | 52 | 114.7 | 99.7 | 12 | 160.0 | 139.1 | 72 | 205.3 | 178.4 |
| 33 | 24.9 | 21.6 | 93 | 70.2 | 61.0 | 53 | 115.5 | 100.4 | 13 | 160.8 | 139.7 | 73 | 206.0 | 179.1 |
| 34 | 25.7 | 22.3 | 94 | 70.9 | 61.7 | 54 | 116.2 | 101.0 | 14 | 161.5 | 140.4 | 74 | 206.8 | 179.8 |
| 35 | 26.4 | 23.0 | 95 | 71.7 | 62.3 | 55 | 117.0 | 101.7 | 15 | 162.3 | 141.1 | 75 | 207.5 | 180.4 |
| 36 | 27.2 | 23.6 | 96 | 72.5 | 63.0 | 56 | 117.7 | 102.3 | 16 | 163.0 | 141.7 | 76 | 208.3 | 181.1 |
| 37 | 27.9 | 24.3 | 97 | 73.2 | 63.6 | 57 | 118.5 | 103.0 | 17 | 163.8 | 142.4 | 77 | 209.1 | 181.7 |
| 38 | 28.7 | 24.9 | 98 | 74.0 | 64.3 | 58 | 119.2 | 103.7 | 18 | 164.5 | 143.0 | 78 | 209.8 | 182.4 |
| 39 | 29.4 | 25.6 | 99 | 74.7 | 64.9 | 59 | 120.0 | 104.3 | 19 | 165.3 | 143.7 | 79 | 210.6 | 183.0 |
| 40 | 30.2 | 26.2 | 100 | 75.5 | 65.6 | 60 | 120.8 | 105.0 | 20 | 166.0 | 144.3 | 80 | 211.3 | 183.7 |
| 41 | 30.9 | 26.9 | 101 | 76.2 | 66.3 | 61 | 121.5 | 105.6 | 221 | 166.8 | 145.0 | 281 | 212.1 | 184.4 |
| 42 | 31.7 | 27.6 | 02 | 77.0 | 66.9 | 62 | 122.3 | 106.3 | 22 | 167.5 | 145.6 | 82 | 212.8 | 185.0 |
| 43 | 32.5 | 28.2 | 03 | 77.7 | 67.6 | 63 | 123.0 | 106.9 | 23 | 168.3 | 146.3 | 83 | 213.6 | 185.7 |
| 44 | 33.2 | 28.9 | 04 | 78.5 | 68.2 | 64 | 123.8 | 107.6 | 24 | 169.1 | 147.0 | 84 | 214.3 | 186.3 |
| 45 | 34.0 | 29.5 | 05 | 79.2 | 68.9 | 65 | 124.5 | 108.2 | 25 | 169.8 | 147.6 | 85 | 215.1 | 187.0 |
| 46 | 34.7 | 30.2 | 06 | 80.0 | 69.5 | 66 | 125.3 | 108.9 | 26 | 170.6 | 148.3 | 86 | 215.8 | 187.6 |
| 47 | 35.5 | 30.8 | 07 | 80.8 | 70.2 | 67 | 126.0 | 109.6 | 27 | 171.3 | 148.9 | 87 | 216.6 | 188.3 |
| 48 | 36.2 | 31.5 | 08 | 81.5 | 70.9 | 68 | 126.8 | 110.2 | 28 | 172.1 | 149.6 | 88 | 217.4 | 188.9 |
| 49 | 37.0 | 32.1 | 09 | 82.3 | 71.5 | 69 | 127.5 | 110.9 | 29 | 172.8 | 150.2 | 89 | 218.1 | 189.6 |
| 50 | 37.7 | 32.8 | 10 | 83.0 | 72.2 | 70 | 128.3 | 111.5 | 30 | 173.6 | 150.9 | 90 | 218.9 | 190.3 |
| 51 | 38.5 | 33.5 | 111 | 83.8 | 72.8 | 171 | 129.1 | 112.2 | 231 | 174.3 | 151.5 | 291 | 219.6 | 190.9 |
| 52 | 39.2 | 34.1 | 12 | 84.5 | 73.5 | 72 | 129.8 | 112.8 | 32 | 175.1 | 152.2 | 92 | 220.4 | 191.6 |
| 53 | 40.0 | 34.8 | 13 | 85.3 | 74.1 | 73 | 130.6 | 113.5 | 33 | 175.8 | 152.9 | 93 | 221.1 | 192.2 |
| 54 | 40.8 | 35.4 | 14 | 86.0 | 74.8 | 74 | 131.3 | 114.2 | 34 | 176.6 | 153.5 | 94 | 221.9 | 192.9 |
| 55 | 41.5 | 36.1 | 15 | 86.8 | 75.4 | 75 | 132.1 | 114.8 | 35 | 177.4 | 154.2 | 95 | 222.6 | 193.5 |
| 56 | 42.3 | 36.7 | 16 | 87.5 | 76.1 | 76 | 132.8 | 115.5 | 36 | 178.1 | 154.8 | 96 | 223.4 | 194.2 |
| 57 | 43.0 | 37.4 | 17 | 88.3 | 76.8 | 77 | 133.6 | 116.1 | 37 | 178.9 | 155.5 | 97 | 224.1 | 194.8 |
| 58 | 43.8 | 38.1 | 18 | 89.1 | 77.4 | 78 | 134.3 | 116.8 | 38 | 179.6 | 156.1 | 98 | 224.9 | 195.5 |
| 59 | 44.5 | 38.7 | 19 | 89.8 | 78.1 | 79 | 135.1 | 117.4 | 39 | 180.4 | 156.8 | 99 | 225.7 | 196.2 |
| 60 | 45.3 | 39.4 | 20 | 90.6 | 78.7 | 80 | 135.8 | 118.1 | 40 | 181.1 | 157.5 | 300 | 226.4 | 196.8 |

| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|
|-------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|------|------|

[For 49 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 42°

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.7 | 0.7 | 61 | 45.3 | 40.8 | 121 | 89.9 | 81.0 | 181 | 134.5 | 121.1 | 241 | 179.1 | 161.3 |
| 2 | 1.5 | 1.3 | 62 | 46.1 | 41.5 | 22 | 90.7 | 81.6 | 82 | 135.3 | 121.8 | 42 | 179.8 | 161.9 |
| 3 | 2.2 | 2.0 | 63 | 46.8 | 42.2 | 23 | 91.4 | 82.3 | 83 | 136.0 | 122.5 | 43 | 180.6 | 162.6 |
| 4 | 3.0 | 2.7 | 64 | 47.6 | 42.8 | 24 | 92.1 | 83.0 | 84 | 136.7 | 123.1 | 44 | 181.3 | 163.3 |
| 5 | 3.7 | 3.3 | 65 | 48.3 | 43.5 | 25 | 92.9 | 83.6 | 85 | 137.5 | 123.8 | 45 | 182.1 | 163.9 |
| 6 | 4.5 | 4.0 | 66 | 49.0 | 44.2 | 26 | 93.6 | 84.3 | 86 | 138.2 | 124.5 | 46 | 182.8 | 164.6 |
| 7 | 5.2 | 4.7 | 67 | 49.8 | 44.8 | 27 | 94.4 | 85.0 | 87 | 139.0 | 125.1 | 47 | 183.6 | 165.3 |
| 8 | 5.9 | 5.4 | 68 | 50.5 | 45.5 | 28 | 95.1 | 85.6 | 88 | 139.7 | 125.8 | 48 | 184.3 | 165.9 |
| 9 | 6.7 | 6.0 | 69 | 51.3 | 46.2 | 29 | 95.9 | 86.3 | 89 | 140.5 | 126.5 | 49 | 185.0 | 166.6 |
| 10 | 7.4 | 6.7 | 70 | 52.0 | 46.8 | 30 | 96.6 | 87.0 | 90 | 141.2 | 127.1 | 50 | 185.8 | 167.3 |
| 11 | 8.2 | 7.4 | 71 | 52.8 | 47.5 | 131 | 97.4 | 87.7 | 191 | 141.9 | 127.8 | 251 | 186.5 | 168.0 |
| 12 | 8.9 | 8.0 | 72 | 53.5 | 48.2 | 32 | 98.1 | 88.3 | 92 | 142.7 | 128.5 | 52 | 187.3 | 168.6 |
| 13 | 9.7 | 8.7 | 73 | 54.2 | 48.8 | 33 | 98.8 | 89.0 | 93 | 143.4 | 129.1 | 53 | 188.0 | 169.3 |
| 14 | 10.4 | 9.4 | 74 | 55.0 | 49.5 | 34 | 99.6 | 89.7 | 94 | 144.2 | 129.8 | 54 | 188.8 | 170.0 |
| 15 | 11.1 | 10.0 | 75 | 55.7 | 50.2 | 35 | 100.3 | 90.3 | 95 | 144.9 | 130.5 | 55 | 189.5 | 170.6 |
| 16 | 11.9 | 10.7 | 76 | 56.5 | 50.9 | 36 | 101.1 | 91.0 | 96 | 145.7 | 131.1 | 56 | 190.2 | 171.3 |
| 17 | 12.6 | 11.4 | 77 | 57.2 | 51.5 | 37 | 101.8 | 91.7 | 97 | 146.4 | 131.8 | 57 | 191.0 | 172.0 |
| 18 | 13.4 | 12.0 | 78 | 58.0 | 52.2 | 38 | 102.6 | 92.3 | 98 | 147.1 | 132.5 | 58 | 191.7 | 172.6 |
| 19 | 14.1 | 12.7 | 79 | 58.7 | 52.9 | 39 | 103.3 | 93.0 | 99 | 147.9 | 133.2 | 59 | 192.5 | 173.3 |
| 20 | 14.9 | 13.4 | 80 | 59.5 | 53.5 | 40 | 104.0 | 93.7 | 200 | 148.6 | 133.8 | 60 | 193.2 | 174.0 |
| 21 | 15.6 | 14.1 | 81 | 60.2 | 54.2 | 141 | 104.8 | 94.3 | 201 | 149.4 | 134.5 | 261 | 194.0 | 174.6 |
| 22 | 16.3 | 14.7 | 82 | 60.9 | 54.9 | 42 | 105.5 | 95.0 | 02 | 150.1 | 135.2 | 62 | 194.7 | 175.3 |
| 23 | 17.1 | 15.4 | 83 | 61.7 | 55.5 | 43 | 106.3 | 95.7 | 03 | 150.9 | 135.8 | 63 | 195.4 | 176.0 |
| 24 | 17.8 | 16.1 | 84 | 62.4 | 56.2 | 44 | 107.0 | 96.4 | 04 | 151.6 | 136.5 | 64 | 196.2 | 176.7 |
| 25 | 18.6 | 16.7 | 85 | 63.2 | 56.9 | 45 | 107.8 | 97.0 | 05 | 152.3 | 137.2 | 65 | 196.9 | 177.3 |
| 26 | 19.3 | 17.4 | 86 | 63.9 | 57.5 | 46 | 108.5 | 97.7 | 06 | 153.1 | 137.8 | 66 | 197.7 | 178.0 |
| 27 | 20.1 | 18.1 | 87 | 64.7 | 58.2 | 47 | 109.2 | 98.4 | 07 | 153.8 | 138.5 | 67 | 198.4 | 178.7 |
| 28 | 20.8 | 18.7 | 88 | 65.4 | 58.9 | 48 | 110.0 | 99.0 | 08 | 154.6 | 139.2 | 68 | 199.2 | 179.3 |
| 29 | 21.6 | 19.4 | 89 | 66.1 | 59.6 | 49 | 110.7 | 99.7 | 09 | 155.3 | 139.8 | 69 | 199.9 | 180.0 |
| 30 | 22.3 | 20.1 | 90 | 66.9 | 60.2 | 50 | 111.5 | 100.4 | 10 | 156.1 | 140.5 | 70 | 200.6 | 180.7 |
| 31 | 23.0 | 20.7 | 91 | 67.6 | 60.9 | 151 | 112.2 | 101.0 | 211 | 156.8 | 141.2 | 271 | 201.4 | 181.3 |
| 32 | 23.8 | 21.4 | 92 | 68.4 | 61.6 | 52 | 113.0 | 101.7 | 12 | 157.5 | 141.9 | 72 | 202.1 | 182.0 |
| 33 | 24.5 | 22.1 | 93 | 69.1 | 62.2 | 53 | 113.7 | 102.4 | 13 | 158.3 | 142.5 | 73 | 202.9 | 182.7 |
| 34 | 25.3 | 22.8 | 94 | 69.9 | 62.9 | 54 | 114.4 | 103.0 | 14 | 159.0 | 143.2 | 74 | 203.6 | 183.3 |
| 35 | 26.0 | 23.4 | 95 | 70.6 | 63.6 | 55 | 115.2 | 103.7 | 15 | 159.8 | 143.9 | 75 | 204.4 | 184.0 |
| 36 | 26.8 | 24.1 | 96 | 71.3 | 64.2 | 56 | 115.9 | 104.4 | 16 | 160.5 | 144.5 | 76 | 205.1 | 184.7 |
| 37 | 27.5 | 24.8 | 97 | 72.1 | 64.9 | 57 | 116.7 | 105.1 | 17 | 161.3 | 145.2 | 77 | 205.9 | 185.3 |
| 38 | 28.2 | 25.4 | 98 | 72.8 | 65.6 | 58 | 117.4 | 105.7 | 18 | 162.0 | 145.9 | 78 | 206.6 | 186.0 |
| 39 | 29.0 | 26.1 | 99 | 73.6 | 66.2 | 59 | 118.2 | 106.4 | 19 | 162.7 | 146.5 | 79 | 207.3 | 186.7 |
| 40 | 29.7 | 26.8 | 100 | 74.3 | 66.9 | 60 | 118.9 | 107.1 | 20 | 163.5 | 147.2 | 80 | 208.1 | 187.4 |
| 41 | 30.5 | 27.4 | 101 | 75.1 | 67.6 | 161 | 119.6 | 107.7 | 221 | 164.2 | 147.9 | 281 | 208.8 | 188.0 |
| 42 | 31.2 | 28.1 | 02 | 75.8 | 68.3 | 62 | 120.4 | 108.4 | 22 | 165.0 | 148.5 | 82 | 209.6 | 188.7 |
| 43 | 32.0 | 28.8 | 03 | 76.5 | 68.9 | 63 | 121.1 | 109.1 | 23 | 165.7 | 149.2 | 83 | 210.3 | 189.4 |
| 44 | 32.7 | 29.4 | 04 | 77.3 | 69.6 | 64 | 121.9 | 109.7 | 24 | 166.5 | 149.9 | 84 | 211.1 | 190.0 |
| 45 | 33.4 | 30.1 | 05 | 78.0 | 70.3 | 65 | 122.6 | 110.4 | 25 | 167.2 | 150.6 | 85 | 211.8 | 190.7 |
| 46 | 34.2 | 30.8 | 06 | 78.8 | 70.9 | 66 | 123.4 | 111.1 | 26 | 168.0 | 151.2 | 86 | 212.5 | 191.4 |
| 47 | 34.9 | 31.4 | 07 | 79.5 | 71.6 | 67 | 124.1 | 111.7 | 27 | 168.7 | 151.9 | 87 | 213.3 | 192.0 |
| 48 | 35.7 | 32.1 | 08 | 80.3 | 72.3 | 68 | 124.8 | 112.4 | 28 | 169.4 | 152.6 | 88 | 214.0 | 192.7 |
| 49 | 36.4 | 32.8 | 09 | 81.0 | 72.9 | 69 | 125.6 | 113.1 | 29 | 170.2 | 153.2 | 89 | 214.8 | 193.4 |
| 50 | 37.2 | 33.5 | 10 | 81.7 | 73.6 | 70 | 126.3 | 113.8 | 30 | 170.9 | 153.9 | 90 | 215.5 | 194.0 |
| 51 | 37.0 | 34.1 | 111 | 82.5 | 74.3 | 171 | 127.1 | 114.4 | 231 | 171.7 | 154.6 | 291 | 216.3 | 194.7 |
| 52 | 38.6 | 34.8 | 12 | 83.2 | 74.9 | 72 | 127.8 | 115.1 | 32 | 172.4 | 155.2 | 92 | 217.0 | 195.4 |
| 53 | 39.4 | 35.5 | 13 | 84.0 | 75.6 | 73 | 128.6 | 115.8 | 33 | 173.2 | 155.9 | 93 | 217.7 | 196.1 |
| 54 | 40.1 | 36.1 | 14 | 84.7 | 76.3 | 74 | 129.3 | 116.4 | 34 | 173.9 | 156.6 | 94 | 218.5 | 196.7 |
| 55 | 40.9 | 36.8 | 15 | 85.5 | 77.0 | 75 | 130.1 | 117.1 | 35 | 174.6 | 157.2 | 95 | 219.2 | 197.4 |
| 56 | 41.6 | 37.5 | 16 | 86.2 | 77.6 | 76 | 130.8 | 117.8 | 36 | 175.4 | 157.9 | 96 | 220.0 | 198.1 |
| 57 | 42.4 | 38.1 | 17 | 86.9 | 78.3 | 77 | 131.5 | 118.4 | 37 | 176.1 | 158.6 | 97 | 220.7 | 198.7 |
| 58 | 43.1 | 38.8 | 18 | 87.7 | 79.0 | 78 | 132.3 | 119.1 | 38 | 176.9 | 159.3 | 98 | 221.5 | 199.4 |
| 59 | 43.8 | 39.5 | 19 | 88.4 | 79.6 | 79 | 133.0 | 119.8 | 39 | 177.6 | 159.9 | 99 | 222.2 | 200.1 |
| 60 | 44.6 | 40.1 | 20 | 89.2 | 80.3 | 80 | 133.8 | 120.4 | 40 | 178.4 | 160.6 | 300 | 222.9 | 200.7 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 48 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 43°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.7 | 0.7 | 61 | 44.6 | 41.6 | 121 | 88.5 | 82.5 | 181 | 132.4 | 123.4 | 241 | 176.3 | 164.4 |
| 2 | 1.5 | 1.4 | 62 | 45.3 | 42.3 | 22 | 89.2 | 83.2 | 82 | 133.1 | 124.1 | 42 | 177.0 | 165.0 |
| 3 | 2.2 | 2.0 | 63 | 46.1 | 43.0 | 23 | 90.0 | 83.9 | 83 | 133.8 | 124.8 | 43 | 177.7 | 165.7 |
| 4 | 2.9 | 2.7 | 64 | 46.8 | 43.6 | 24 | 90.7 | 84.6 | 84 | 134.6 | 125.5 | 44 | 178.5 | 166.4 |
| 5 | 3.7 | 3.4 | 65 | 47.5 | 44.3 | 25 | 91.4 | 85.2 | 85 | 135.3 | 126.2 | 45 | 179.2 | 167.1 |
| 6 | 4.4 | 4.1 | 66 | 48.3 | 45.0 | 26 | 92.2 | 85.9 | 86 | 136.0 | 126.9 | 46 | 179.9 | 167.8 |
| 7 | 5.1 | 4.8 | 67 | 49.0 | 45.7 | 27 | 92.9 | 86.6 | 87 | 136.8 | 127.5 | 47 | 180.6 | 168.5 |
| 8 | 5.9 | 5.5 | 68 | 49.7 | 46.4 | 28 | 93.6 | 87.3 | 88 | 137.5 | 128.2 | 48 | 181.4 | 169.1 |
| 9 | 6.6 | 6.1 | 69 | 50.5 | 47.1 | 29 | 94.3 | 88.0 | 89 | 138.2 | 128.9 | 49 | 182.1 | 169.8 |
| 10 | 7.3 | 6.8 | 70 | 51.2 | 47.7 | 30 | 95.1 | 88.7 | 90 | 139.0 | 129.6 | 50 | 182.8 | 170.5 |
| 11 | 8.0 | 7.5 | 71 | 51.9 | 48.4 | 131 | 95.8 | 89.3 | 191 | 139.7 | 130.3 | 251 | 183.6 | 171.2 |
| 12 | 8.8 | 8.2 | 72 | 52.7 | 49.1 | 32 | 96.5 | 90.0 | 92 | 140.4 | 130.9 | 52 | 184.3 | 171.9 |
| 13 | 9.5 | 8.9 | 73 | 53.4 | 49.8 | 33 | 97.3 | 90.7 | 93 | 141.2 | 131.6 | 53 | 185.0 | 172.5 |
| 14 | 10.2 | 9.5 | 74 | 54.1 | 50.5 | 34 | 98.0 | 91.4 | 94 | 141.9 | 132.3 | 54 | 185.8 | 173.2 |
| 15 | 11.0 | 10.2 | 75 | 54.9 | 51.1 | 35 | 98.7 | 92.1 | 95 | 142.6 | 133.0 | 55 | 186.5 | 173.9 |
| 16 | 11.7 | 10.9 | 76 | 55.6 | 51.8 | 36 | 99.5 | 92.8 | 96 | 143.3 | 133.7 | 56 | 187.2 | 174.6 |
| 17 | 12.4 | 11.6 | 77 | 56.3 | 52.5 | 37 | 100.2 | 93.4 | 97 | 144.1 | 134.4 | 57 | 188.0 | 175.3 |
| 18 | 13.2 | 12.3 | 78 | 57.0 | 53.2 | 38 | 100.9 | 94.1 | 98 | 144.8 | 135.0 | 58 | 188.7 | 176.0 |
| 19 | 13.9 | 13.0 | 79 | 57.8 | 53.9 | 39 | 101.7 | 94.8 | 99 | 145.5 | 135.7 | 59 | 189.4 | 176.6 |
| 20 | 14.6 | 13.6 | 80 | 58.5 | 54.6 | 40 | 102.4 | 95.5 | 200 | 146.3 | 136.4 | 60 | 190.2 | 177.3 |
| 21 | 15.4 | 14.3 | 81 | 59.2 | 55.2 | 141 | 103.1 | 96.2 | 201 | 147.0 | 137.1 | 261 | 190.9 | 178.0 |
| 22 | 16.1 | 15.0 | 82 | 60.0 | 55.9 | 42 | 103.9 | 96.8 | 02 | 147.7 | 137.8 | 62 | 191.6 | 178.7 |
| 23 | 16.8 | 15.7 | 83 | 60.7 | 56.6 | 43 | 104.6 | 97.5 | 03 | 148.5 | 138.4 | 63 | 192.3 | 179.4 |
| 24 | 17.6 | 16.4 | 84 | 61.4 | 57.3 | 44 | 105.3 | 98.2 | 04 | 149.2 | 139.1 | 64 | 193.1 | 180.0 |
| 25 | 18.3 | 17.0 | 85 | 62.2 | 58.0 | 45 | 106.0 | 98.9 | 05 | 149.9 | 139.8 | 65 | 193.8 | 180.7 |
| 26 | 19.0 | 17.7 | 86 | 62.9 | 58.7 | 46 | 106.8 | 99.6 | 06 | 150.7 | 140.5 | 66 | 194.5 | 181.4 |
| 27 | 19.7 | 18.4 | 87 | 63.6 | 59.3 | 47 | 107.5 | 100.3 | 07 | 151.4 | 141.2 | 67 | 195.3 | 182.1 |
| 28 | 20.5 | 19.1 | 88 | 64.4 | 60.0 | 48 | 108.2 | 100.9 | 08 | 152.1 | 141.9 | 68 | 196.0 | 182.8 |
| 29 | 21.2 | 19.8 | 89 | 65.1 | 60.7 | 49 | 109.0 | 101.6 | 09 | 152.9 | 142.5 | 69 | 196.7 | 183.5 |
| 30 | 21.9 | 20.5 | 90 | 65.8 | 61.4 | 50 | 109.7 | 102.3 | 10 | 153.6 | 143.2 | 70 | 197.5 | 184.1 |
| 31 | 22.7 | 21.1 | 91 | 66.6 | 62.1 | 151 | 110.4 | 103.0 | 211 | 154.3 | 143.9 | 271 | 198.2 | 184.8 |
| 32 | 23.4 | 21.8 | 92 | 67.3 | 62.7 | 52 | 111.2 | 103.7 | 12 | 155.0 | 144.6 | 72 | 198.9 | 185.5 |
| 33 | 24.1 | 22.5 | 93 | 68.0 | 63.4 | 53 | 111.9 | 104.3 | 13 | 155.8 | 145.3 | 73 | 199.7 | 186.2 |
| 34 | 24.9 | 23.2 | 94 | 68.7 | 64.1 | 54 | 112.6 | 105.0 | 14 | 156.5 | 145.9 | 74 | 200.4 | 186.9 |
| 35 | 25.6 | 23.9 | 95 | 69.5 | 64.8 | 55 | 113.4 | 105.7 | 15 | 157.2 | 146.6 | 75 | 201.1 | 187.5 |
| 36 | 26.3 | 24.6 | 96 | 70.2 | 65.5 | 56 | 114.1 | 106.4 | 16 | 158.0 | 147.3 | 76 | 201.9 | 188.2 |
| 37 | 27.1 | 25.2 | 97 | 70.9 | 66.2 | 57 | 114.8 | 107.1 | 17 | 158.7 | 148.0 | 77 | 202.6 | 188.9 |
| 38 | 27.8 | 25.9 | 98 | 71.7 | 66.8 | 58 | 115.6 | 107.8 | 18 | 159.4 | 148.7 | 78 | 203.3 | 189.6 |
| 39 | 28.5 | 26.6 | 99 | 72.4 | 67.5 | 59 | 116.3 | 108.4 | 19 | 160.2 | 149.4 | 79 | 204.0 | 190.3 |
| 40 | 29.3 | 27.3 | 100 | 73.1 | 68.2 | 60 | 117.0 | 109.1 | 20 | 160.9 | 150.0 | 80 | 204.8 | 191.0 |
| 41 | 30.0 | 28.0 | 101 | 73.9 | 68.9 | 161 | 117.7 | 109.8 | 221 | 161.6 | 150.7 | 281 | 205.5 | 191.6 |
| 42 | 30.7 | 28.6 | 02 | 74.6 | 69.6 | 62 | 118.5 | 110.5 | 22 | 162.4 | 151.4 | 82 | 206.2 | 192.3 |
| 43 | 31.4 | 29.3 | 03 | 75.3 | 70.2 | 63 | 119.2 | 111.2 | 23 | 163.1 | 152.1 | 83 | 207.0 | 193.0 |
| 44 | 32.2 | 30.0 | 04 | 76.1 | 70.9 | 64 | 119.9 | 111.8 | 24 | 163.8 | 152.8 | 84 | 207.7 | 193.7 |
| 45 | 32.9 | 30.7 | 05 | 76.8 | 71.6 | 65 | 120.7 | 112.5 | 25 | 164.6 | 153.4 | 85 | 208.4 | 194.4 |
| 46 | 33.6 | 31.4 | 06 | 77.5 | 72.3 | 66 | 121.4 | 113.2 | 26 | 165.3 | 154.1 | 86 | 209.2 | 195.1 |
| 47 | 34.4 | 32.1 | 07 | 78.3 | 73.0 | 67 | 122.1 | 113.9 | 27 | 166.0 | 154.8 | 87 | 209.9 | 195.7 |
| 48 | 35.1 | 32.7 | 08 | 79.0 | 73.7 | 68 | 122.9 | 114.6 | 28 | 166.7 | 155.5 | 88 | 210.6 | 196.4 |
| 49 | 35.8 | 33.4 | 09 | 79.7 | 74.3 | 69 | 123.6 | 115.3 | 29 | 167.5 | 156.2 | 89 | 211.4 | 197.1 |
| 50 | 36.6 | 34.1 | 10 | 80.4 | 75.0 | 70 | 124.3 | 115.9 | 30 | 168.2 | 156.9 | 90 | 212.1 | 197.8 |
| 51 | 37.3 | 34.8 | 111 | 81.2 | 75.7 | 171 | 125.1 | 116.6 | 231 | 168.9 | 157.5 | 291 | 212.8 | 198.5 |
| 52 | 38.0 | 35.5 | 12 | 81.9 | 76.4 | 72 | 125.8 | 117.3 | 32 | 169.7 | 158.2 | 92 | 213.6 | 199.1 |
| 53 | 38.8 | 36.1 | 13 | 82.6 | 77.1 | 73 | 126.5 | 118.0 | 33 | 170.4 | 158.9 | 93 | 214.3 | 199.8 |
| 54 | 39.5 | 36.8 | 14 | 83.4 | 77.7 | 74 | 127.3 | 118.7 | 34 | 171.1 | 159.6 | 94 | 215.0 | 200.5 |
| 55 | 40.2 | 37.5 | 15 | 84.1 | 78.4 | 75 | 128.0 | 119.3 | 35 | 171.9 | 160.3 | 95 | 215.7 | 201.2 |
| 56 | 41.0 | 38.2 | 16 | 84.8 | 79.1 | 76 | 128.7 | 120.0 | 36 | 172.6 | 161.0 | 96 | 216.5 | 201.9 |
| 57 | 41.7 | 38.9 | 17 | 85.6 | 79.8 | 77 | 129.4 | 120.7 | 37 | 173.3 | 161.6 | 97 | 217.2 | 202.6 |
| 58 | 42.4 | 39.6 | 18 | 86.3 | 80.5 | 78 | 130.2 | 121.4 | 38 | 174.1 | 162.3 | 98 | 217.9 | 203.3 |
| 59 | 43.1 | 40.2 | 19 | 87.0 | 81.2 | 79 | 130.9 | 122.1 | 39 | 174.8 | 163.0 | 99 | 218.7 | 203.9 |
| 60 | 43.9 | 40.9 | 20 | 87.8 | 81.8 | 80 | 131.6 | 122.8 | 40 | 175.5 | 163.7 | 300 | 219.4 | 204.6 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 47 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 44°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.7 | 0.7 | 61 | 43.9 | 42.4 | 121 | 87.0 | 84.1 | 181 | 130.2 | 125.7 | 241 | 173.4 | 167.4 |
| 2 | 1.4 | 1.4 | 62 | 44.6 | 43.1 | 22 | 87.8 | 84.7 | 82 | 130.9 | 126.4 | 42 | 174.1 | 168.1 |
| 3 | 2.2 | 2.1 | 63 | 45.3 | 43.8 | 23 | 88.5 | 85.4 | 83 | 131.6 | 127.1 | 43 | 174.8 | 168.8 |
| 4 | 2.9 | 2.8 | 64 | 46.0 | 44.5 | 24 | 89.2 | 86.1 | 84 | 132.4 | 127.8 | 44 | 175.5 | 169.5 |
| 5 | 3.6 | 3.5 | 65 | 46.8 | 45.2 | 25 | 89.9 | 86.8 | 85 | 133.1 | 128.5 | 45 | 176.2 | 170.2 |
| 6 | 4.3 | 4.2 | 66 | 47.5 | 45.8 | 26 | 90.6 | 87.5 | 86 | 133.8 | 129.2 | 46 | 177.0 | 170.9 |
| 7 | 5.0 | 4.9 | 67 | 48.2 | 46.5 | 27 | 91.4 | 88.2 | 87 | 134.5 | 129.9 | 47 | 177.7 | 171.6 |
| 8 | 5.8 | 5.6 | 68 | 48.9 | 47.2 | 28 | 92.1 | 88.9 | 88 | 135.2 | 130.6 | 48 | 178.4 | 172.3 |
| 9 | 6.5 | 6.3 | 69 | 49.6 | 47.9 | 29 | 92.8 | 89.6 | 89 | 136.0 | 131.3 | 49 | 179.1 | 173.0 |
| 10 | 7.2 | 6.9 | 70 | 50.4 | 48.6 | 30 | 93.5 | 90.3 | 90 | 136.7 | 132.0 | 50 | 179.8 | 173.7 |
| 11 | 7.9 | 7.6 | 71 | 51.1 | 49.3 | 131 | 94.2 | 91.0 | 191 | 137.4 | 132.7 | 251 | 180.6 | 174.4 |
| 12 | 8.6 | 8.3 | 72 | 51.8 | 50.0 | 32 | 95.0 | 91.7 | 92 | 138.1 | 133.4 | 52 | 181.3 | 175.1 |
| 13 | 9.4 | 9.0 | 73 | 52.5 | 50.7 | 33 | 95.7 | 92.4 | 93 | 138.8 | 134.1 | 53 | 182.0 | 175.7 |
| 14 | 10.1 | 9.7 | 74 | 53.2 | 51.4 | 34 | 96.4 | 93.1 | 94 | 139.6 | 134.8 | 54 | 182.7 | 176.4 |
| 15 | 10.8 | 10.4 | 75 | 54.0 | 52.1 | 35 | 97.1 | 93.8 | 95 | 140.3 | 135.5 | 55 | 183.4 | 177.1 |
| 16 | 11.5 | 11.1 | 76 | 54.7 | 52.8 | 36 | 97.8 | 94.5 | 96 | 141.0 | 136.2 | 56 | 184.2 | 177.8 |
| 17 | 12.2 | 11.8 | 77 | 55.4 | 53.5 | 37 | 98.5 | 95.2 | 97 | 141.7 | 136.8 | 57 | 184.9 | 178.5 |
| 18 | 12.9 | 12.5 | 78 | 56.1 | 54.2 | 38 | 99.3 | 95.9 | 98 | 142.4 | 137.5 | 58 | 185.6 | 179.2 |
| 19 | 13.7 | 13.2 | 79 | 56.8 | 54.9 | 39 | 100.0 | 96.6 | 99 | 143.1 | 138.2 | 59 | 186.3 | 179.9 |
| 20 | 14.4 | 13.9 | 80 | 57.5 | 55.6 | 40 | 100.7 | 97.3 | 200 | 143.9 | 138.9 | 60 | 187.0 | 180.6 |
| 21 | 15.1 | 14.6 | 81 | 58.3 | 56.3 | 141 | 101.4 | 97.9 | 201 | 144.6 | 139.6 | 261 | 187.7 | 181.3 |
| 22 | 15.8 | 15.3 | 82 | 59.0 | 57.0 | 42 | 102.1 | 98.6 | 02 | 145.3 | 140.3 | 62 | 188.5 | 182.0 |
| 23 | 16.5 | 16.0 | 83 | 59.7 | 57.7 | 43 | 102.9 | 99.3 | 03 | 146.0 | 141.0 | 63 | 189.2 | 182.7 |
| 24 | 17.3 | 16.7 | 84 | 60.4 | 58.4 | 44 | 103.6 | 100.0 | 04 | 146.7 | 141.7 | 64 | 189.9 | 183.4 |
| 25 | 18.0 | 17.4 | 85 | 61.1 | 59.0 | 45 | 104.3 | 100.7 | 05 | 147.5 | 142.4 | 65 | 190.6 | 184.1 |
| 26 | 18.7 | 18.1 | 86 | 61.9 | 59.7 | 46 | 105.0 | 101.4 | 06 | 148.2 | 143.1 | 66 | 191.3 | 184.8 |
| 27 | 19.4 | 18.8 | 87 | 62.6 | 60.4 | 47 | 105.7 | 102.1 | 07 | 148.9 | 143.8 | 67 | 192.1 | 185.5 |
| 28 | 20.1 | 19.5 | 88 | 63.3 | 61.1 | 48 | 106.5 | 102.8 | 08 | 149.6 | 144.5 | 68 | 192.8 | 186.2 |
| 29 | 20.9 | 20.1 | 89 | 64.0 | 61.8 | 49 | 107.2 | 103.5 | 09 | 150.3 | 145.2 | 69 | 193.5 | 186.9 |
| 30 | 21.6 | 20.8 | 90 | 64.7 | 62.5 | 50 | 107.9 | 104.2 | 10 | 151.1 | 145.9 | 70 | 194.2 | 187.6 |
| 31 | 22.3 | 21.5 | 91 | 65.5 | 63.2 | 151 | 108.6 | 104.9 | 211 | 151.8 | 146.6 | 271 | 194.9 | 188.3 |
| 32 | 23.0 | 22.2 | 92 | 66.2 | 63.9 | 52 | 109.3 | 105.6 | 12 | 152.5 | 147.3 | 72 | 195.7 | 188.9 |
| 33 | 23.7 | 22.9 | 93 | 66.9 | 64.6 | 53 | 110.1 | 106.3 | 13 | 153.2 | 148.0 | 73 | 196.4 | 189.6 |
| 34 | 24.5 | 23.6 | 94 | 67.6 | 65.3 | 54 | 110.8 | 107.0 | 14 | 153.9 | 148.7 | 74 | 197.1 | 190.3 |
| 35 | 25.2 | 24.3 | 95 | 68.3 | 66.0 | 55 | 111.5 | 107.7 | 15 | 154.7 | 149.4 | 75 | 197.8 | 191.0 |
| 36 | 25.9 | 25.0 | 96 | 69.1 | 66.7 | 56 | 112.2 | 108.4 | 16 | 155.4 | 150.0 | 76 | 198.5 | 191.7 |
| 37 | 26.6 | 25.7 | 97 | 69.8 | 67.4 | 57 | 112.9 | 109.1 | 17 | 156.1 | 150.7 | 77 | 199.3 | 192.4 |
| 38 | 27.3 | 26.4 | 98 | 70.5 | 68.1 | 58 | 113.7 | 109.8 | 18 | 156.8 | 151.4 | 78 | 200.0 | 193.1 |
| 39 | 28.1 | 27.1 | 99 | 71.2 | 68.8 | 59 | 114.4 | 110.5 | 19 | 157.5 | 152.1 | 79 | 200.7 | 193.8 |
| 40 | 28.8 | 27.8 | 100 | 71.9 | 69.5 | 60 | 115.1 | 111.1 | 20 | 158.3 | 152.8 | 80 | 201.4 | 194.5 |
| 41 | 29.5 | 28.5 | 101 | 72.7 | 70.2 | 161 | 115.8 | 111.8 | 221 | 159.0 | 153.5 | 281 | 202.1 | 195.2 |
| 42 | 30.2 | 29.2 | 02 | 73.4 | 70.9 | 62 | 116.5 | 112.5 | 22 | 159.7 | 154.2 | 82 | 202.9 | 195.9 |
| 43 | 30.9 | 29.9 | 03 | 74.1 | 71.5 | 63 | 117.3 | 113.2 | 23 | 160.4 | 154.9 | 83 | 203.6 | 196.6 |
| 44 | 31.7 | 30.6 | 04 | 74.8 | 72.2 | 64 | 118.0 | 113.9 | 24 | 161.1 | 155.6 | 84 | 204.3 | 197.3 |
| 45 | 32.4 | 31.3 | 05 | 75.5 | 72.9 | 65 | 118.7 | 114.6 | 25 | 161.8 | 156.3 | 85 | 205.0 | 198.0 |
| 46 | 33.1 | 32.0 | 06 | 76.3 | 73.6 | 66 | 119.4 | 115.3 | 26 | 162.6 | 157.0 | 86 | 205.7 | 198.7 |
| 47 | 33.8 | 32.6 | 07 | 77.0 | 74.3 | 67 | 120.1 | 116.0 | 27 | 163.3 | 157.7 | 87 | 206.5 | 199.4 |
| 48 | 34.5 | 33.3 | 08 | 77.7 | 75.0 | 68 | 120.8 | 116.7 | 28 | 164.0 | 158.4 | 88 | 207.2 | 200.1 |
| 49 | 35.2 | 34.0 | 09 | 78.4 | 75.7 | 69 | 121.6 | 117.4 | 29 | 164.7 | 159.1 | 89 | 207.9 | 200.8 |
| 50 | 36.0 | 34.7 | 10 | 79.1 | 76.4 | 70 | 122.3 | 118.1 | 30 | 165.4 | 159.8 | 90 | 208.6 | 201.5 |
| 51 | 36.7 | 35.4 | 111 | 79.8 | 77.1 | 171 | 123.0 | 118.8 | 231 | 166.2 | 160.5 | 291 | 209.3 | 202.1 |
| 52 | 37.4 | 36.1 | 12 | 80.6 | 77.8 | 72 | 123.7 | 119.5 | 32 | 166.9 | 161.2 | 92 | 210.0 | 202.8 |
| 53 | 38.1 | 36.8 | 13 | 81.3 | 78.5 | 73 | 124.4 | 120.2 | 33 | 167.6 | 161.9 | 93 | 210.8 | 203.5 |
| 54 | 38.8 | 37.5 | 14 | 82.0 | 79.2 | 74 | 125.2 | 120.9 | 34 | 168.3 | 162.6 | 94 | 211.5 | 204.2 |
| 55 | 39.6 | 38.2 | 15 | 82.7 | 79.9 | 75 | 125.9 | 121.6 | 35 | 169.0 | 163.2 | 95 | 212.2 | 204.9 |
| 56 | 40.3 | 38.9 | 16 | 83.4 | 80.6 | 76 | 126.6 | 122.3 | 36 | 169.8 | 163.9 | 96 | 212.9 | 205.6 |
| 57 | 41.0 | 39.6 | 17 | 84.2 | 81.3 | 77 | 127.3 | 123.0 | 37 | 170.5 | 164.6 | 97 | 213.6 | 206.3 |
| 58 | 41.7 | 40.3 | 18 | 84.9 | 82.0 | 78 | 128.0 | 123.6 | 38 | 171.2 | 165.3 | 98 | 214.4 | 207.0 |
| 59 | 42.4 | 41.0 | 19 | 85.6 | 82.7 | 79 | 128.8 | 124.3 | 39 | 171.9 | 166.0 | 99 | 215.1 | 207.7 |
| 60 | 43.2 | 41.7 | 20 | 86.3 | 83.4 | 80 | 129.5 | 125.0 | 40 | 172.6 | 166.7 | 300 | 215.8 | 208.4 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 46 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 45°.

| Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. | Dist. | Lat. | Dep. |
|-------|------|------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 0.7 | 0.7 | 61 | 43.1 | 43.1 | 121 | 85.6 | 85.6 | 181 | 128.0 | 128.0 | 241 | 170.4 | 170.4 |
| 2 | 1.4 | 1.4 | 62 | 43.8 | 43.8 | 22 | 85.3 | 85.3 | 82 | 128.7 | 128.7 | 42 | 171.1 | 171.1 |
| 3 | 2.1 | 2.1 | 63 | 44.5 | 44.5 | 23 | 87.0 | 87.0 | 83 | 129.4 | 129.4 | 43 | 171.8 | 171.8 |
| 4 | 2.8 | 2.8 | 64 | 45.3 | 45.3 | 24 | 87.7 | 87.7 | 84 | 130.1 | 130.1 | 44 | 172.5 | 172.5 |
| 5 | 3.5 | 3.5 | 65 | 46.0 | 46.0 | 25 | 88.4 | 88.4 | 85 | 130.8 | 130.8 | 45 | 173.2 | 173.2 |
| 6 | 4.2 | 4.2 | 66 | 46.7 | 46.7 | 26 | 89.1 | 89.1 | 86 | 131.5 | 131.5 | 46 | 173.9 | 173.9 |
| 7 | 4.9 | 4.9 | 67 | 47.4 | 47.4 | 27 | 89.8 | 89.8 | 87 | 132.2 | 132.2 | 47 | 174.7 | 174.7 |
| 8 | 5.7 | 5.7 | 68 | 48.1 | 48.1 | 28 | 90.5 | 90.5 | 88 | 132.9 | 132.9 | 48 | 175.4 | 175.4 |
| 9 | 6.4 | 6.4 | 69 | 48.8 | 48.8 | 29 | 91.2 | 91.2 | 89 | 133.6 | 133.6 | 49 | 176.1 | 176.1 |
| 10 | 7.1 | 7.1 | 70 | 49.5 | 49.5 | 30 | 91.9 | 91.9 | 90 | 134.4 | 134.4 | 50 | 176.8 | 176.8 |
| 11 | 7.8 | 7.8 | 71 | 50.2 | 50.2 | 31 | 92.6 | 92.6 | 91 | 135.1 | 135.1 | 51 | 177.5 | 177.5 |
| 12 | 8.5 | 8.5 | 72 | 50.9 | 50.9 | 32 | 93.3 | 93.3 | 92 | 135.8 | 135.8 | 52 | 178.2 | 178.2 |
| 13 | 9.2 | 9.2 | 73 | 51.6 | 51.6 | 33 | 94.0 | 94.0 | 93 | 136.5 | 136.5 | 53 | 178.9 | 178.9 |
| 14 | 9.9 | 9.9 | 74 | 52.3 | 52.3 | 34 | 94.8 | 94.8 | 94 | 137.2 | 137.2 | 54 | 179.6 | 179.6 |
| 15 | 10.6 | 10.6 | 75 | 53.0 | 53.0 | 35 | 95.5 | 95.5 | 95 | 137.9 | 137.9 | 55 | 180.3 | 180.3 |
| 16 | 11.3 | 11.3 | 76 | 53.7 | 53.7 | 36 | 96.2 | 96.2 | 96 | 138.6 | 138.6 | 56 | 181.0 | 181.0 |
| 17 | 12.0 | 12.0 | 77 | 54.4 | 54.4 | 37 | 96.9 | 96.9 | 97 | 139.3 | 139.3 | 57 | 181.7 | 181.7 |
| 18 | 12.7 | 12.7 | 78 | 55.2 | 55.2 | 38 | 97.6 | 97.6 | 98 | 140.0 | 140.0 | 58 | 182.4 | 182.4 |
| 19 | 13.4 | 13.4 | 79 | 55.9 | 55.9 | 39 | 98.3 | 98.3 | 99 | 140.7 | 140.7 | 59 | 183.1 | 183.1 |
| 20 | 14.1 | 14.1 | 80 | 56.6 | 56.6 | 40 | 99.0 | 99.0 | 200 | 141.4 | 141.4 | 60 | 183.8 | 183.8 |
| 21 | 14.8 | 14.8 | 81 | 57.3 | 57.3 | 41 | 99.7 | 99.7 | 201 | 142.1 | 142.1 | 61 | 184.6 | 184.6 |
| 22 | 15.6 | 15.6 | 82 | 58.0 | 58.0 | 42 | 100.4 | 100.4 | 02 | 142.8 | 142.8 | 62 | 185.3 | 185.3 |
| 23 | 16.3 | 16.3 | 83 | 58.7 | 58.7 | 43 | 101.1 | 101.1 | 03 | 143.5 | 143.5 | 63 | 186.0 | 186.0 |
| 24 | 17.0 | 17.0 | 84 | 59.4 | 59.4 | 44 | 101.8 | 101.8 | 04 | 144.2 | 144.2 | 64 | 186.7 | 186.7 |
| 25 | 17.7 | 17.7 | 85 | 60.1 | 60.1 | 45 | 102.5 | 102.5 | 05 | 145.0 | 145.0 | 65 | 187.4 | 187.4 |
| 26 | 18.4 | 18.4 | 86 | 60.8 | 60.8 | 46 | 103.2 | 103.2 | 06 | 145.7 | 145.7 | 66 | 188.1 | 188.1 |
| 27 | 19.1 | 19.1 | 87 | 61.5 | 61.5 | 47 | 103.9 | 103.9 | 07 | 146.4 | 146.4 | 67 | 188.8 | 188.8 |
| 28 | 19.8 | 19.8 | 88 | 62.2 | 62.2 | 48 | 104.7 | 104.7 | 08 | 147.1 | 147.1 | 68 | 189.5 | 189.5 |
| 29 | 20.5 | 20.5 | 89 | 62.9 | 62.9 | 49 | 105.4 | 105.4 | 09 | 147.8 | 147.8 | 69 | 190.2 | 190.2 |
| 30 | 21.2 | 21.2 | 90 | 63.6 | 63.6 | 50 | 106.1 | 106.1 | 10 | 148.5 | 148.5 | 70 | 190.9 | 190.9 |
| 31 | 21.9 | 21.9 | 91 | 64.3 | 64.3 | 51 | 106.8 | 106.8 | 211 | 149.2 | 149.2 | 271 | 191.6 | 191.6 |
| 32 | 22.6 | 22.6 | 92 | 65.1 | 65.1 | 52 | 107.5 | 107.5 | 12 | 149.9 | 149.9 | 72 | 192.3 | 192.3 |
| 33 | 23.3 | 23.3 | 93 | 65.8 | 65.8 | 53 | 108.2 | 108.2 | 13 | 150.6 | 150.6 | 73 | 193.0 | 193.0 |
| 34 | 24.0 | 24.0 | 94 | 66.5 | 66.5 | 54 | 108.9 | 108.9 | 14 | 151.3 | 151.3 | 74 | 193.7 | 193.7 |
| 35 | 24.7 | 24.7 | 95 | 67.2 | 67.2 | 55 | 109.6 | 109.6 | 15 | 152.0 | 152.0 | 75 | 194.5 | 194.5 |
| 36 | 25.5 | 25.5 | 96 | 67.9 | 67.9 | 56 | 110.3 | 110.3 | 16 | 152.7 | 152.7 | 76 | 195.2 | 195.2 |
| 37 | 26.2 | 26.2 | 97 | 68.6 | 68.6 | 57 | 111.0 | 111.0 | 17 | 153.4 | 153.4 | 77 | 195.9 | 195.9 |
| 38 | 26.9 | 26.9 | 98 | 69.3 | 69.3 | 58 | 111.7 | 111.7 | 18 | 154.1 | 154.1 | 78 | 196.6 | 196.6 |
| 39 | 27.6 | 27.6 | 99 | 70.0 | 70.0 | 59 | 112.4 | 112.4 | 19 | 154.9 | 154.9 | 79 | 197.3 | 197.3 |
| 40 | 28.3 | 28.3 | 100 | 70.7 | 70.7 | 60 | 113.1 | 113.1 | 20 | 155.6 | 155.6 | 80 | 198.0 | 198.0 |
| 41 | 29.0 | 29.0 | 101 | 71.4 | 71.4 | 101 | 113.8 | 113.8 | 221 | 156.3 | 156.3 | 281 | 198.7 | 198.7 |
| 42 | 29.7 | 29.7 | 02 | 72.1 | 72.1 | 62 | 114.6 | 114.6 | 22 | 157.0 | 157.0 | 82 | 199.4 | 199.4 |
| 43 | 30.4 | 30.4 | 03 | 72.8 | 72.8 | 63 | 115.3 | 115.3 | 23 | 157.7 | 157.7 | 83 | 200.1 | 200.1 |
| 44 | 31.1 | 31.1 | 04 | 73.5 | 73.5 | 64 | 116.0 | 116.0 | 24 | 158.4 | 158.4 | 84 | 200.8 | 200.8 |
| 45 | 31.8 | 31.8 | 05 | 74.2 | 74.2 | 65 | 116.7 | 116.7 | 25 | 159.1 | 159.1 | 85 | 201.5 | 201.5 |
| 46 | 32.5 | 32.5 | 06 | 75.0 | 75.0 | 66 | 117.4 | 117.4 | 26 | 159.8 | 159.8 | 86 | 202.2 | 202.2 |
| 47 | 33.2 | 33.2 | 07 | 75.7 | 75.7 | 67 | 118.1 | 118.1 | 27 | 160.5 | 160.5 | 87 | 202.9 | 202.9 |
| 48 | 33.9 | 33.9 | 08 | 76.4 | 76.4 | 68 | 118.8 | 118.8 | 28 | 161.2 | 161.2 | 88 | 203.6 | 203.6 |
| 49 | 34.6 | 34.6 | 09 | 77.1 | 77.1 | 69 | 119.5 | 119.5 | 29 | 161.9 | 161.9 | 89 | 204.4 | 204.4 |
| 50 | 35.4 | 35.4 | 10 | 77.8 | 77.8 | 70 | 120.2 | 120.2 | 30 | 162.6 | 162.6 | 90 | 205.1 | 205.1 |
| 51 | 36.1 | 36.1 | 111 | 78.5 | 78.5 | 171 | 120.9 | 120.9 | 231 | 163.3 | 163.3 | 291 | 205.8 | 205.8 |
| 52 | 36.8 | 36.8 | 12 | 79.2 | 79.2 | 72 | 121.6 | 121.6 | 32 | 164.0 | 164.0 | 92 | 206.5 | 206.5 |
| 53 | 37.5 | 37.5 | 13 | 79.9 | 79.9 | 73 | 122.3 | 122.3 | 33 | 164.8 | 164.8 | 93 | 207.2 | 207.2 |
| 54 | 38.2 | 38.2 | 14 | 80.6 | 80.6 | 74 | 123.0 | 123.0 | 34 | 165.5 | 165.5 | 94 | 207.9 | 207.9 |
| 55 | 38.9 | 38.9 | 15 | 81.3 | 81.3 | 75 | 123.7 | 123.7 | 35 | 166.2 | 166.2 | 95 | 208.6 | 208.6 |
| 56 | 39.6 | 39.6 | 16 | 82.0 | 82.0 | 76 | 124.5 | 124.5 | 36 | 166.9 | 166.9 | 96 | 209.3 | 209.3 |
| 57 | 40.3 | 40.3 | 17 | 82.7 | 82.7 | 77 | 125.2 | 125.2 | 37 | 167.6 | 167.6 | 97 | 210.0 | 210.0 |
| 58 | 41.0 | 41.0 | 18 | 83.4 | 83.4 | 78 | 125.9 | 125.9 | 38 | 168.3 | 168.3 | 98 | 210.7 | 210.7 |
| 59 | 41.7 | 41.7 | 19 | 84.1 | 84.1 | 79 | 126.6 | 126.6 | 39 | 169.0 | 169.0 | 99 | 211.4 | 211.4 |
| 60 | 42.4 | 42.4 | 20 | 84.9 | 84.9 | 80 | 127.3 | 127.3 | 40 | 169.7 | 169.7 | 300 | 212.1 | 212.1 |
| Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. | Dist. | Dep. | Lat. |

[For 45 Degrees.]

TABLE II.

REFRACTION, DIP, AND PARALLAX.

REFRACTION, DIP, AND PARALLAX.

| | | | | | | | | | | | | | | | | | | | | DIP OF THE SEA HORIZON. | |
|--------------------|----|-------------|----|--------------------|----|-------------|----|--------------------|---|-------------|----|--------------------|---|-------------|----|--------------------|---|-------------|----|-------------------------|---------------------|
| Apparent Altitude. | | Refraction. | | Apparent Altitude. | | Refraction. | | Apparent Altitude. | | Refraction. | | Apparent Altitude. | | Refraction. | | Apparent Altitude. | | Refraction. | | Height of the Eye. | Dip of the Horizon. |
| ° | ' | ' | " | ° | ' | ' | " | ° | ' | ' | " | ° | ' | ' | " | ° | ' | ' | " | | |
| 0 | 0 | 36 | 29 | 9 | 30 | 5 | 35 | 15 | 0 | 3 | 34 | 25 | 0 | 2 | 4 | 42 | 0 | 1 | 5 | Ft. | ' " |
| 1 | 0 | 24 | 53 | 35 | 5 | 32 | | 10 | 3 | 32 | | 10 | 2 | 3 | | 20 | 1 | 3 | | | |
| 2 | 0 | 18 | 25 | 40 | 5 | 29 | | 20 | 3 | 29 | | 20 | 2 | 2 | | 40 | 1 | 3 | | | |
| 3 | 0 | 14 | 25 | 45 | 5 | 27 | | 30 | 3 | 27 | | 30 | 2 | 1 | | 43 | 0 | 1 | 2 | | |
| 4 | 0 | 11 | 44 | 50 | 5 | 24 | | 40 | 3 | 25 | | 40 | 2 | 1 | | 20 | 1 | 2 | | | |
| 5 | 0 | 9 | 52 | 55 | 5 | 22 | | 50 | 3 | 22 | | 50 | 2 | 0 | | 40 | 1 | 1 | | | |
| 5 | 5 | 9 | 44 | 10 | 0 | 5 | 19 | 16 | 0 | 3 | 20 | 26 | 0 | 1 | 59 | 44 | 0 | 1 | 0 | | |
| 10 | 5 | 9 | 36 | 5 | 5 | 17 | | 10 | 3 | 18 | | 10 | 1 | 58 | | 20 | 0 | 59 | | | |
| 15 | 9 | 28 | | 10 | 5 | 14 | | 20 | 3 | 16 | | 20 | 1 | 57 | | 40 | 0 | 59 | | | |
| 20 | 9 | 21 | | 15 | 5 | 12 | | 30 | 3 | 14 | | 30 | 1 | 56 | | 45 | 0 | 0 | 58 | | |
| 25 | 9 | 14 | | 20 | 5 | 9 | | 40 | 3 | 12 | | 40 | 1 | 55 | | 20 | 0 | 57 | | | |
| 5 | 30 | 9 | 7 | 25 | 5 | 7 | | 50 | 3 | 10 | | 50 | 1 | 54 | | 40 | 0 | 57 | | | |
| 35 | 9 | 0 | | 10 | 30 | 5 | 5 | 17 | 0 | 3 | 8 | 27 | 0 | 1 | 54 | 46 | 0 | 0 | 56 | | |
| 40 | 8 | 53 | | 35 | 5 | 2 | | 10 | 3 | 6 | | 10 | 1 | 53 | | 20 | 0 | 55 | | | |
| 45 | 8 | 47 | | 40 | 5 | 0 | | 20 | 3 | 5 | | 20 | 1 | 52 | | 40 | 0 | 55 | | | |
| 50 | 8 | 46 | | 45 | 4 | 58 | | 30 | 3 | 3 | | 30 | 1 | 51 | | 47 | 0 | 0 | 54 | | |
| 55 | 8 | 34 | | 50 | 4 | 56 | | 40 | 3 | 1 | | 40 | 1 | 51 | | 20 | 0 | 54 | | | |
| 6 | 0 | 8 | 28 | 55 | 4 | 53 | | 50 | 2 | 59 | | 50 | 1 | 50 | | 40 | 0 | 53 | | | |
| 5 | 8 | 22 | | 11 | 0 | 4 | 51 | 18 | 0 | 2 | 57 | 28 | 0 | 1 | 49 | 48 | 0 | 0 | 52 | | |
| 10 | 8 | 16 | | 5 | 4 | 49 | | 10 | 2 | 56 | | 20 | 1 | 48 | | 49 | 0 | 9 | 50 | | |
| 15 | 8 | 10 | | 10 | 4 | 47 | | 20 | 2 | 54 | | 40 | 1 | 46 | | 50 | 0 | 0 | 49 | | |
| 20 | 8 | 5 | | 15 | 4 | 45 | | 30 | 2 | 52 | | 29 | 0 | 1 | 45 | 51 | 0 | 0 | 47 | | |
| 25 | 7 | 59 | | 20 | 4 | 43 | | 40 | 2 | 51 | | 20 | 1 | 43 | | 52 | 0 | 0 | 45 | | |
| 6 | 30 | 7 | 54 | 25 | 4 | 41 | | 50 | 2 | 49 | | 40 | 1 | 42 | | 53 | 0 | 0 | 44 | | |
| 35 | 7 | 49 | | 11 | 30 | 4 | 39 | 19 | 0 | 2 | 48 | 30 | 0 | 1 | 40 | 54 | 0 | 0 | 42 | | |
| 40 | 7 | 43 | | 25 | 4 | 37 | | 10 | 2 | 46 | | 20 | 1 | 39 | | 55 | 0 | 0 | 41 | | |
| 45 | 7 | 38 | | 40 | 4 | 35 | | 20 | 2 | 45 | | 40 | 1 | 38 | | 56 | 0 | 0 | 39 | | |
| 50 | 7 | 33 | | 45 | 4 | 33 | | 30 | 2 | 43 | | 31 | 0 | 1 | 37 | 57 | 0 | 0 | 37 | | |
| 55 | 7 | 28 | | 50 | 4 | 31 | | 40 | 2 | 42 | | 20 | 1 | 35 | | 58 | 0 | 0 | 36 | | |
| 7 | 0 | 7 | 24 | 55 | 4 | 29 | | 50 | 2 | 40 | | 40 | 1 | 34 | | 59 | 0 | 0 | 35 | | |
| 5 | 7 | 19 | | 12 | 0 | 4 | 27 | 20 | 0 | 2 | 39 | 32 | 0 | 1 | 33 | 60 | 0 | 0 | 33 | | |
| 10 | 7 | 14 | | 5 | 4 | 26 | | 10 | 2 | 37 | | 20 | 1 | 32 | | 61 | 0 | 0 | 32 | | |
| 15 | 7 | 10 | | 10 | 4 | 24 | | 20 | 2 | 36 | | 40 | 1 | 31 | | 62 | 0 | 0 | 31 | | |
| 20 | 7 | 6 | | 15 | 4 | 22 | | 30 | 2 | 35 | | 33 | 0 | 1 | 29 | 63 | 0 | 0 | 30 | | |
| 25 | 7 | 1 | | 20 | 4 | 20 | | 40 | 2 | 33 | | 20 | 1 | 28 | | 64 | 0 | 0 | 28 | | |
| 7 | 30 | 6 | 57 | 25 | 4 | 19 | | 50 | 2 | 32 | | 40 | 1 | 27 | | 65 | 0 | 0 | 27 | | |
| 35 | 6 | 53 | | 12 | 30 | 4 | 17 | 21 | 0 | 2 | 31 | 34 | 0 | 1 | 26 | 66 | 0 | 0 | 26 | | |
| 40 | 6 | 49 | | 35 | 4 | 15 | | 10 | 2 | 29 | | 20 | 1 | 25 | | 67 | 0 | 0 | 25 | | |
| 45 | 6 | 45 | | 40 | 4 | 13 | | 20 | 2 | 28 | | 40 | 1 | 24 | | 68 | 0 | 0 | 23 | | |
| 50 | 6 | 41 | | 45 | 4 | 12 | | 30 | 2 | 27 | | 35 | 0 | 1 | 23 | 69 | 0 | 0 | 22 | | |
| 55 | 6 | 37 | | 50 | 4 | 10 | | 40 | 2 | 26 | | 20 | 1 | 22 | | 70 | 0 | 0 | 21 | | |
| 8 | 0 | 6 | 33 | 55 | 4 | 9 | | 50 | 2 | 24 | | 40 | 1 | 21 | | 71 | 0 | 0 | 20 | | |
| 5 | 6 | 29 | | 13 | 0 | 4 | 7 | 22 | 0 | 2 | 23 | 36 | 0 | 1 | 20 | 72 | 0 | 0 | 19 | | |
| 10 | 6 | 25 | | 5 | 4 | 5 | | 10 | 2 | 22 | | 20 | 1 | 19 | | 73 | 0 | 0 | 18 | | |
| 15 | 6 | 22 | | 10 | 4 | 4 | | 20 | 2 | 21 | | 40 | 1 | 18 | | 74 | 0 | 0 | 17 | | |
| 20 | 6 | 19 | | 15 | 4 | 2 | | 30 | 2 | 20 | | 37 | 0 | 1 | 17 | 75 | 0 | 0 | 15 | | |
| 25 | 6 | 15 | | 20 | 4 | 1 | | 40 | 2 | 19 | | 20 | 1 | 16 | | 76 | 0 | 0 | 14 | | |
| 8 | 30 | 6 | 12 | 25 | 3 | 59 | | 50 | 2 | 17 | | 40 | 1 | 15 | | 77 | 0 | 0 | 13 | | |
| 35 | 6 | 8 | | 13 | 30 | 3 | 58 | 23 | 0 | 2 | 16 | 38 | 0 | 1 | 14 | 78 | 0 | 0 | 12 | | |
| 40 | 6 | 5 | | 35 | 3 | 56 | | 10 | 2 | 15 | | 20 | 1 | 13 | | 79 | 0 | 0 | 11 | | |
| 45 | 6 | 2 | | 40 | 3 | 55 | | 20 | 2 | 14 | | 40 | 1 | 12 | | 80 | 0 | 0 | 10 | | |
| 50 | 5 | 59 | | 45 | 3 | 54 | | 30 | 2 | 13 | | 39 | 0 | 1 | 11 | 81 | 0 | 0 | 9 | | |
| 55 | 5 | 56 | | 50 | 3 | 52 | | 40 | 2 | 12 | | 20 | 1 | 11 | | 82 | 0 | 0 | 8 | | |
| 9 | 0 | 5 | 52 | 55 | 3 | 51 | | 50 | 2 | 11 | | 40 | 1 | 10 | | 83 | 0 | 0 | 8 | | |
| 5 | 5 | 49 | | 14 | 0 | 3 | 49 | 24 | 0 | 2 | 10 | 40 | 0 | 1 | 9 | 84 | 0 | 0 | 6 | | |
| 10 | 5 | 46 | | 10 | 3 | 47 | | 10 | 2 | 9 | | 20 | 1 | 8 | | 85 | 0 | 0 | 5 | | |
| 15 | 5 | 43 | | 20 | 3 | 44 | | 20 | 2 | 8 | | 40 | 1 | 8 | | 86 | 0 | 0 | 4 | | |
| 20 | 5 | 41 | | 30 | 3 | 41 | | 30 | 2 | 7 | | 41 | 0 | 1 | 7 | 87 | 0 | 0 | 3 | | |
| 25 | 5 | 38 | | 40 | 3 | 39 | | 40 | 2 | 6 | | 20 | 1 | 6 | | 88 | 0 | 0 | 2 | | |
| 9 | 30 | 5 | 35 | 50 | 3 | 36 | | 50 | 2 | 5 | | 40 | 1 | 5 | | 89 | 0 | 0 | 1 | | |
| 15 | 0 | 3 | 34 | 25 | 0 | 2 | 4 | 25 | 0 | 2 | 4 | 42 | 0 | 1 | 4 | 90 | 0 | 0 | 0 | | |

THE SUN'S PARALLAX IN ALTITUDE.

| Sun's Alt. | Sun's Parallax. |
|------------|-----------------|
| D. | S. |
| 0 | 9 |
| 10 | 9 |
| 20 | 8 |
| 30 | 8 |
| 40 | 7 |
| 50 | 6 |
| 55 | 5 |
| 60 | 4 |
| 65 | 4 |
| 70 | 3 |
| 75 | 2 |
| 80 | 2 |
| 85 | 1 |
| 90 | 0 |

TABLE III.

DECLINATION OF THE SUN,

1886-1901.

DECLINATION OF THE SUN FOR THE YEARS 1886, 1890, 1894, 1898.

| Days. | JAN. | | | FEB. | | | MAR. | | | APRIL. | | | MAY. | | | JUNE. | | | Days. | |
|-------|-------|--------|-----------------|-------|--------|-----------------|------|--------|--------|-----------------|------|--------|-----------------|------|--------|-----------------|------|--------|-------|-----------------|
| | Dec. | South. | Diff. one hour. | Dec. | South. | Diff. one hour. | Dec. | South. | North. | Diff. one hour. | Dec. | North. | Diff. one hour. | Dec. | North. | Diff. one hour. | Dec. | North. | | Diff. one hour. |
| | ° | ' | | ° | ' | | ° | ' | | | ° | ' | | ° | ' | | ° | ' | | |
| 1 | 22.59 | | +13 | 17.02 | | +43 | 7.30 | | +57 | 4.37 | | +58 | 15.08 | | +45 | 22.05 | | +20 | 1 | |
| 2 | 22.54 | | 14 | 16.44 | | 44 | 7.07 | | 57 | 5.00 | | 58 | 15.26 | | 45 | 22.13 | | 19 | 2 | |
| 3 | 22.48 | | 15 | 16.27 | | 44 | 6.44 | | 57 | 5.23 | | 57 | 15.44 | | 44 | 22.20 | | 18 | 3 | |
| 4 | 22.42 | | 16 | 16.09 | | 45 | 6.21 | | 58 | 5.46 | | 57 | 16.01 | | 43 | 22.28 | | 17 | 4 | |
| 5 | 22.35 | | +17 | 15.51 | | +46 | 5.58 | | +58 | 6.09 | | +57 | 16.18 | | +43 | 22.34 | | +16 | 5 | |
| 6 | 22.28 | | 18 | 15.32 | | 46 | 5.34 | | 58 | 6.32 | | 57 | 16.35 | | 42 | 22.41 | | 15 | 6 | |
| 7 | 22.21 | | 19 | 15.14 | | 47 | 5.11 | | 58 | 6.54 | | 56 | 16.52 | | 41 | 22.47 | | 14 | 7 | |
| 8 | 22.13 | | 20 | 14.55 | | 48 | 4.48 | | 58 | 7.17 | | 56 | 17.08 | | 41 | 22.52 | | 13 | 8 | |
| 9 | 22.04 | | 22 | 14.35 | | 48 | 4.24 | | 59 | 7.39 | | 56 | 17.25 | | 40 | 22.57 | | 12 | 9 | |
| 10 | 21.55 | | +23 | 14.16 | | +49 | 4.01 | | +59 | 8.01 | | +55 | 17.40 | | +39 | 23.02 | | +11 | 10 | |
| 11 | 21.46 | | 24 | 13.56 | | 49 | 3.37 | | 59 | 8.23 | | 55 | 17.56 | | 38 | 23.06 | | 10 | 11 | |
| 12 | 21.36 | | 25 | 13.36 | | 50 | 3.14 | | 59 | 8.45 | | 55 | 18.11 | | 38 | 23.10 | | 9 | 12 | |
| 13 | 21.26 | | 26 | 13.16 | | 51 | 2.50 | | 59 | 9.07 | | 54 | 18.26 | | 37 | 23.14 | | 8 | 13 | |
| 14 | 21.16 | | 27 | 12.55 | | 51 | 2.26 | | 59 | 9.29 | | 54 | 18.40 | | 36 | 23.17 | | 7 | 14 | |
| 15 | 21.05 | | +28 | 12.25 | | +52 | 2.03 | | +59 | 9.50 | | +53 | 18.55 | | +35 | 23.20 | | +6 | 15 | |
| 16 | 20.53 | | 29 | 12.15 | | 52 | 1.39 | | 59 | 10.12 | | 53 | 19.09 | | 34 | 23.22 | | 5 | 16 | |
| 17 | 20.42 | | 30 | 11.54 | | 53 | 1.15 | | 59 | 10.32 | | 53 | 19.22 | | 34 | 23.24 | | 4 | 17 | |
| 18 | 20.30 | | 31 | 11.33 | | 53 | 0.52 | | 59 | 10.54 | | 52 | 19.36 | | 33 | 23.25 | | 3 | 18 | |
| 19 | 20.17 | | 32 | 11.11 | | 53 | 0.28 | | 59 | 11.15 | | 52 | 19.49 | | 32 | 23.26 | | 2 | 19 | |
| 20 | 20.04 | | +33 | 10.50 | | +54 | 0.04 | | +59 | 11.35 | | +51 | 20.01 | | +31 | 23.27 | | +1 | 20 | |
| 21 | 19.51 | | 34 | 10.28 | | 54 | 0.19 | | 59 | 11.56 | | 51 | 20.13 | | 30 | 23.27 | | 0 | 21 | |
| 22 | 19.37 | | 35 | 10.06 | | 55 | 0.43 | | 59 | 12.16 | | 50 | 20.25 | | 29 | 23.27 | | -1 | 22 | |
| 23 | 19.23 | | 35 | 9.44 | | 55 | 1.07 | | 59 | 12.36 | | 50 | 20.37 | | 28 | 23.26 | | 2 | 23 | |
| 24 | 19.09 | | 36 | 9.22 | | 55 | 1.30 | | 59 | 12.56 | | 49 | 20.48 | | 28 | 23.25 | | 3 | 24 | |
| 25 | 18.54 | | +37 | 9.00 | | +56 | 1.54 | | +59 | 13.15 | | +49 | 20.59 | | +27 | 23.24 | | -4 | 25 | |
| 26 | 18.39 | | 38 | 8.38 | | 56 | 2.17 | | 59 | 13.35 | | 48 | 21.10 | | 26 | 23.22 | | 5 | 26 | |
| 27 | 18.24 | | 39 | 8.15 | | 56 | 2.41 | | 59 | 13.54 | | 48 | 21.20 | | 25 | 23.20 | | 6 | 27 | |
| 28 | 18.08 | | 40 | 7.52 | | 57 | 3.04 | | 58 | 14.13 | | 47 | 21.30 | | 24 | 23.17 | | 7 | 28 | |
| 29 | 17.52 | | 41 | 7.30 | | 57 | 3.28 | | 58 | 14.31 | | 46 | 21.39 | | 23 | 23.14 | | 8 | 29 | |
| 30 | 17.35 | | +41 | | | | 3.51 | | +58 | 14.50 | | +46 | 21.48 | | +22 | 23.10 | | -9 | 30 | |
| 31 | 17.19 | | 42 | | | | 4.14 | | 58 | 15.08 | | 45 | 21.57 | | 21 | 23.07 | | 10 | 31 | |
| 32 | 17.02 | | 43 | | | | 4.37 | | 58 | | | | 22.05 | | 20 | | | | 32 | |

DECLINATION OF THE SUN FOR THE YEARS 1886, 1890, 1894, 1898.

| Days. | JULY. | | AUGUST. | | SEPT. | | OCT. | | Nov. | | DEC. | | Days. |
|-------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------|
| | Dec. North. | Diff. one hour. | Dec. North. | Diff. one hour. | Dec. North. | Diff. one hour. | Dec. South. | Diff. one hour. | Dec. South. | Diff. one hour. | Dec. South. | Diff. one hour. | |
| | ° ' " | " | ° ' " | " | ° ' " | " | ° ' " | " | ° ' " | " | ° ' " | " | |
| 1 | 23.07 | -10 | 17.59 | -38 | 8.13 | -54 | 3.16 | -58 | 14.30 | -48 | 21.51 | -23 | 1 |
| 2 | 23.02 | 11 | 17.44 | 39 | 7.52 | 55 | 3.39 | 58 | 14.49 | 47 | 22.00 | 22 | 2 |
| 3 | 22.58 | 12 | 17.28 | 39 | 7.30 | 55 | 4.02 | 58 | 15.08 | 47 | 22.09 | 21 | 3 |
| 4 | 22.52 | 13 | 17.12 | 40 | 7.07 | 55 | 4.25 | 58 | 15.27 | 46 | 22.17 | 20 | 4 |
| 5 | 22.47 | -14 | 16.56 | -41 | 6.45 | -56 | 4.48 | -58 | 15.45 | -45 | 22.25 | -19 | 5 |
| 6 | 22.41 | 15 | 16.40 | 41 | 6.23 | 56 | 5.12 | 58 | 16.03 | 45 | 22.32 | 18 | 6 |
| 7 | 22.35 | 16 | 16.23 | 42 | 6.00 | 56 | 5.35 | 57 | 16.21 | 44 | 22.39 | 17 | 7 |
| 8 | 22.28 | 17 | 16.06 | 43 | 5.38 | 56 | 5.57 | 57 | 16.39 | 43 | 22.45 | 15 | 8 |
| 9 | 22.21 | 18 | 15.49 | 43 | 5.15 | 57 | 6.20 | 57 | 16.56 | 43 | 22.51 | 14 | 9 |
| 10 | 22.14 | -19 | 15.32 | -44 | 4.52 | 57 | 6.43 | -57 | 17.13 | -42 | 22.57 | -13 | 10 |
| 11 | 22.06 | 20 | 15.14 | 45 | 4.30 | 57 | 7.06 | 57 | 17.29 | 41 | 23.02 | 12 | 11 |
| 12 | 21.58 | 21 | 14.56 | 45 | 4.07 | 57 | 7.28 | 56 | 17.46 | 40 | 23.06 | 11 | 12 |
| 13 | 21.49 | 22 | 14.38 | 46 | 3.44 | 57 | 7.51 | 56 | 18.02 | 40 | 23.10 | 10 | 13 |
| 14 | 21.40 | 23 | 14.19 | 46 | 3.21 | 58 | 8.13 | 56 | 18.18 | 39 | 23.14 | 9 | 14 |
| 15 | 21.31 | -24 | 14.01 | -47 | 2.58 | -58 | 8.36 | -55 | 18.33 | -38 | 23.17 | -7 | 15 |
| 16 | 21.21 | 25 | 13.42 | 47 | 2.35 | 58 | 8.58 | 55 | 18.43 | 37 | 23.20 | 6 | 16 |
| 17 | 21.11 | 26 | 13.23 | 48 | 2.11 | 58 | 9.20 | 55 | 19.03 | 36 | 23.22 | 5 | 17 |
| 18 | 21.01 | 26 | 13.03 | 48 | 1.48 | 58 | 9.42 | 54 | 19.17 | 36 | 23.24 | 4 | 18 |
| 19 | 20.59 | 27 | 12.44 | 49 | 1.25 | 58 | 10.03 | 54 | 19.31 | 35 | 23.26 | 3 | 19 |
| 20 | 20.39 | -28 | 12.24 | -50 | 1.01 | -58 | 10.25 | -54 | 19.45 | -34 | 23.27 | -2 | 20 |
| 21 | 20.27 | 29 | 12.04 | 50 | 0.30 | 58 | 10.46 | 53 | 19.58 | 33 | 23.27 | 0 | 21 |
| 22 | 20.15 | 30 | 11.44 | 50 | 0.15 | 58 | 11.08 | 53 | 20.11 | 32 | 23.27 | +1 | 22 |
| 23 | 20.03 | 31 | 11.24 | 51 | 0.08 | 58 | 11.29 | 52 | 20.24 | 31 | 23.26 | 2 | 23 |
| 24 | 19.51 | 32 | 11.03 | 51 | 0.32 | 58 | 11.50 | 52 | 20.36 | 30 | 23.25 | 3 | 24 |
| 25 | 19.38 | -32 | 10.42 | -52 | 0.55 | -58 | 12.10 | -52 | 20.48 | -29 | 23.24 | +4 | 25 |
| 26 | 19.25 | 33 | 10.22 | 52 | 1.19 | 58 | 12.31 | 51 | 21.00 | 28 | 23.22 | 5 | 26 |
| 27 | 19.11 | 34 | 10.01 | 53 | 1.42 | 58 | 12.51 | 51 | 21.11 | 27 | 23.20 | 7 | 27 |
| 28 | 18.57 | 35 | 9.40 | 53 | 2.06 | 58 | 13.12 | 50 | 21.21 | 26 | 23.17 | 8 | 28 |
| 29 | 18.43 | 36 | 9.18 | 53 | 2.28 | 58 | 13.32 | 50 | 21.32 | 25 | 23.13 | 9 | 29 |
| 30 | 18.29 | -36 | 8.57 | -54 | 2.52 | -58 | 13.51 | -49 | 21.42 | -24 | 23.10 | +10 | 30 |
| 31 | 18.14 | 37 | 8.35 | 54 | 3.16 | 58 | 14.11 | 49 | 21.51 | 23 | 23.05 | 11 | 31 |
| 32 | 17.59 | 38 | 8.13 | 54 | | | 14.30 | 48 | | | 23.01 | 12 | 32 |

DECLINATION OF THE SUN FOR THE YEARS 1887, 1891, 1895, 1899.

| Days. | JAN. | | FEB. | | MAR. | | APRIL. | | MAY. | | JUNE. | | Days. |
|-------|-------|-----------------|-------|-----------------|-------|-----------------|--------|-----------------|-------|-----------------|-------|-----------------|-------|
| | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | |
| | ° ' " | | ° ' " | | ° ' " | | ° ' " | | ° ' " | | ° ' " | | |
| 1 | 23.01 | +12 | 17.06 | +43 | 7.35 | +57 | 4.32 | +58 | 15.04 | +45 | 22.03 | +20 | 1 |
| 2 | 22.55 | 13 | 16.49 | 43 | 7.12 | 57 | 4.55 | 58 | 15.22 | 45 | 22.11 | 19 | 2 |
| 3 | 22.50 | 15 | 16.31 | 44 | 6.49 | 57 | 5.18 | 57 | 15.40 | 44 | 22.19 | 18 | 3 |
| 4 | 22.44 | 16 | 16.13 | 45 | 6.26 | 58 | 5.40 | 57 | 15.57 | 43 | 22.26 | 17 | 4 |
| 5 | 22.37 | +17 | 15.55 | +46 | 6.03 | +58 | 6.04 | +57 | 16.14 | +43 | 22.33 | +17 | 5 |
| 6 | 22.30 | 18 | 15.37 | 46 | 5.40 | 58 | 6.26 | 57 | 16.31 | 42 | 22.39 | 16 | 6 |
| 7 | 22.23 | 19 | 15.18 | 47 | 5.17 | 58 | 6.49 | 56 | 16.48 | 41 | 22.45 | 15 | 7 |
| 8 | 22.15 | 20 | 14.59 | 47 | 4.53 | 58 | 7.11 | 56 | 17.04 | 41 | 22.51 | 14 | 8 |
| 9 | 22.06 | 21 | 14.40 | 48 | 4.30 | 59 | 7.34 | 56 | 17.21 | 40 | 22.56 | 13 | 9 |
| 10 | 21.58 | +22 | 14.21 | +49 | 4.06 | +59 | 7.56 | +55 | 17.38 | +39 | 23.01 | +12 | 10 |
| 11 | 21.48 | 23 | 14.01 | 49 | 3.43 | 59 | 8.18 | 55 | 17.52 | 39 | 23.05 | 10 | 11 |
| 12 | 21.39 | 24 | 13.41 | 50 | 3.19 | 59 | 8.40 | 55 | 18.07 | 38 | 23.09 | 10 | 12 |
| 13 | 21.29 | 26 | 13.21 | 50 | 2.56 | 59 | 9.02 | 54 | 18.22 | 37 | 23.13 | 8 | 13 |
| 14 | 21.18 | 27 | 13.01 | 51 | 2.32 | 59 | 9.24 | 54 | 18.37 | 36 | 23.16 | 7 | 14 |
| 15 | 21.08 | +28 | 12.40 | +51 | 2.08 | +59 | 9.45 | +54 | 18.51 | +35 | 23.19 | +6 | 15 |
| 16 | 20.56 | 29 | 12.20 | 52 | 1.45 | 59 | 10.06 | 53 | 19.05 | 35 | 23.21 | 5 | 16 |
| 17 | 20.45 | 30 | 11.59 | 52 | 1.21 | 59 | 10.28 | 53 | 19.19 | 34 | 23.23 | 4 | 17 |
| 18 | 20.33 | 31 | 11.38 | 53 | 0.57 | 59 | 10.49 | 52 | 19.32 | 33 | 23.25 | 3 | 18 |
| 19 | 20.20 | 32 | 11.16 | 53 | 0.34 | 59 | 11.09 | 52 | 19.45 | 32 | 23.26 | 2 | 19 |
| 20 | 20.07 | +32 | 10.55 | +54 | 0.10 | +59 | 11.30 | +51 | 19.58 | +31 | 23.27 | +1 | 20 |
| 21 | 19.54 | 33 | 10.33 | 54 | 0.14 | 59 | 11.51 | 51 | 20.10 | 30 | 23.27 | 0 | 21 |
| 22 | 19.41 | 34 | 10.12 | 55 | 0.37 | 59 | 12.11 | 50 | 20.23 | 30 | 23.27 | -1 | 22 |
| 23 | 19.27 | 35 | 9.50 | 55 | 1.01 | 59 | 12.31 | 50 | 20.34 | 29 | 23.26 | 2 | 23 |
| 24 | 19.12 | 36 | 9.28 | 55 | 1.24 | 59 | 12.51 | 49 | 20.46 | 28 | 23.25 | 3 | 24 |
| 25 | 18.58 | +37 | 9.05 | +56 | 1.48 | +59 | 13.10 | +49 | 20.57 | +27 | 23.24 | -4 | 25 |
| 26 | 18.43 | 38 | 8.43 | 56 | 2.12 | 59 | 13.30 | 48 | 21.07 | 26 | 23.22 | 5 | 26 |
| 27 | 18.27 | 39 | 8.20 | 56 | 2.35 | 59 | 13.49 | 48 | 21.17 | 25 | 23.20 | 6 | 27 |
| 28 | 18.12 | 39 | 7.58 | 57 | 2.59 | 59 | 14.08 | 47 | 21.27 | 24 | 23.18 | 7 | 28 |
| 29 | 17.56 | 40 | 7.35 | 57 | 3.22 | 59 | 14.27 | 47 | 21.37 | 23 | 23.15 | 8 | 29 |
| 30 | 17.39 | +41 | | | 3.45 | +58 | 14.45 | +46 | 21.46 | 22 | 23.11 | -9 | 30 |
| 31 | 17.23 | 42 | | | 4.09 | 58 | 15.04 | 45 | 21.55 | 21 | 23.08 | 10 | 31 |
| 32 | 17.06 | 43 | | | 4.32 | 58 | | | 22.03 | 20 | | | 32 |

DECLINATION OF THE SUN FOR THE YEARS 1887, 1891, 1895, 1899.

| Days. | JULY. | | AUG. | | SEPT. | | OCT. | | NOV. | | DEC. | | Days. |
|-------|-------|-----------------|-------|-----------------|-------|-----------------|-------|-----------------|-------|-----------------|-------|-----------------|-------|
| | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | |
| | ° ' " | " | ° ' " | " | ° ' " | " | ° ' " | " | ° ' " | " | ° ' " | " | |
| 1 | 23.08 | -10 | 18.03 | -38 | 8.19 | -54 | 3.10 | -58 | 14.26 | -48 | 21.49 | -23 | 1 |
| 2 | 23.03 | 11 | 17.48 | 38 | 7.57 | 55 | 3.33 | 58 | 14.45 | 47 | 21.58 | 22 | 2 |
| 3 | 22.59 | 12 | 17.32 | 39 | 7.35 | 55 | 3.56 | 58 | 15.04 | 47 | 22.07 | 21 | 3 |
| 4 | 22.54 | 13 | 17.16 | 40 | 7.13 | 55 | 4.20 | 58 | 15.22 | 46 | 22.15 | 20 | 4 |
| 5 | 22.48 | -14 | 17.00 | -41 | 6.51 | -56 | 4.43 | -58 | 15.41 | -46 | 22.23 | -19 | 5 |
| 6 | 22.43 | 15 | 16.44 | 41 | 6.28 | 56 | 5.06 | 58 | 15.59 | 45 | 22.30 | 18 | 6 |
| 7 | 22.36 | 16 | 16.27 | 42 | 6.06 | 56 | 5.29 | 57 | 16.17 | 44 | 22.37 | 17 | 7 |
| 8 | 22.30 | 17 | 16.10 | 42 | 5.43 | 56 | 5.52 | 57 | 16.34 | 44 | 22.44 | 16 | 8 |
| 9 | 22.23 | 18 | 15.53 | 43 | 5.21 | 57 | 6.15 | 57 | 16.52 | 43 | 22.50 | 15 | 9 |
| 10 | 22.15 | -19 | 15.36 | -44 | 4.58 | -57 | 6.37 | -57 | 17.09 | -42 | 22.55 | -13 | 10 |
| 11 | 22.08 | 20 | 15.18 | 44 | 4.35 | 57 | 7.00 | 57 | 17.25 | 41 | 23.01 | 12 | 11 |
| 12 | 22.00 | 21 | 15.00 | 45 | 4.12 | 57 | 7.23 | 56 | 17.42 | 41 | 23.05 | 11 | 12 |
| 13 | 21.51 | 22 | 14.42 | 46 | 3.49 | 57 | 7.45 | 56 | 17.58 | 40 | 23.10 | 10 | 13 |
| 14 | 21.42 | 23 | 14.24 | 46 | 3.26 | 58 | 8.08 | 56 | 18.14 | 39 | 23.13 | 9 | 14 |
| 15 | 21.33 | -23 | 14.05 | -47 | 3.03 | -58 | 8.30 | -55 | 18.29 | -38 | 23.17 | -8 | 15 |
| 16 | 21.23 | 24 | 13.46 | 47 | 2.40 | 58 | 8.52 | 55 | 18.44 | 37 | 23.20 | 7 | 16 |
| 17 | 21.13 | 25 | 13.27 | 48 | 2.17 | 58 | 9.14 | 55 | 18.59 | 37 | 23.22 | 5 | 17 |
| 18 | 21.03 | 26 | 13.08 | 48 | 1.54 | 58 | 9.36 | 55 | 19.14 | 36 | 23.24 | 4 | 18 |
| 19 | 20.52 | 27 | 12.48 | 49 | 1.30 | 58 | 9.58 | 54 | 19.28 | 35 | 23.25 | 3 | 19 |
| 20 | 20.41 | -28 | 12.29 | -49 | 1.07 | -58 | 10.20 | -54 | 19.42 | -34 | 23.26 | -2 | 20 |
| 21 | 20.30 | 29 | 12.09 | 50 | 0.44 | 58 | 10.41 | 53 | 19.55 | 32 | 23.27 | 1 | 21 |
| 22 | 20.18 | 30 | 11.49 | 50 | 0.20 | 58 | 11.02 | 53 | 20.08 | 32 | 23.27 | +0 | 22 |
| 23 | 20.06 | 31 | 11.28 | 51 | 0.03 | 58 | 11.24 | 52 | 20.21 | 31 | 23.27 | 2 | 23 |
| 24 | 19.54 | 31 | 11.08 | 51 | 0.26 | 58 | 11.45 | 52 | 20.33 | 30 | 23.26 | 3 | 24 |
| 25 | 19.41 | -32 | 10.48 | -52 | 0.50 | -58 | 12.05 | -52 | 20.45 | -29 | 23.24 | +4 | 25 |
| 26 | 19.28 | 33 | 10.27 | 52 | 1.13 | 58 | 12.26 | 52 | 20.57 | 28 | 23.23 | 5 | 26 |
| 27 | 19.14 | 34 | 10.06 | 53 | 1.33 | 58 | 12.46 | 51 | 21.08 | 27 | 23.20 | 6 | 27 |
| 28 | 19.01 | 35 | 9.45 | 53 | 2.00 | 58 | 13.07 | 50 | 21.19 | 26 | 23.18 | 7 | 28 |
| 29 | 18.47 | 35 | 9.23 | 53 | 2.23 | 58 | 13.27 | 50 | 21.29 | 25 | 23.14 | 9 | 29 |
| 30 | 18.33 | -36 | 9.02 | -54 | 2.47 | -58 | 13.47 | -49 | 21.39 | -24 | 23.10 | +10 | 30 |
| 31 | 18.18 | 37 | 8.40 | 54 | 3.10 | 58 | 14.06 | 49 | 21.49 | 23 | 23.06 | 11 | 31 |
| 32 | 18.03 | 38 | 8.19 | 54 | | | 14.25 | 48 | | | 23.02 | 12 | 32 |

DECLINATION OF THE SUN FOR THE YEARS 1888, 1892, 1896, 1900.

| Days. | JAN. | | | FEB. | | | MARCH. | | | APRIL. | | | MAY. | | | JUNE. | | | Days. | |
|-------|-------|--------|-----------------|-------|--------|-----------------|--------|--------|--------|-----------------|------|--------|-----------------|------|--------|-----------------|------|--------|-------|-----------------|
| | Dec. | South. | Diff. one hour. | Dec. | South. | Diff. one hour. | Dec. | South. | North. | Diff. one hour. | Dec. | North. | Diff. one hour. | Dec. | North. | Diff. one hour. | Dec. | North. | | Diff. one hour. |
| | | | | | | | | | | | | | | | | | | | | |
| 1 | 23.02 | | +12 | 17.10 | | +42 | 7.17 | | +57 | 4.49 | | +58 | 15.17 | | +45 | 22.09 | | +20 | 1 | |
| 2 | 22.57 | 13 | | 16.53 | 43 | | 6.55 | 57 | | 5.12 | 57 | | 15.35 | 44 | | 22.17 | 19 | | 2 | |
| 3 | 22.51 | 14 | | 16.35 | 44 | | 6.32 | 58 | | 5.35 | 57 | | 15.53 | 44 | | 22.24 | 18 | | 3 | |
| 4 | 22.45 | 15 | | 16.18 | 45 | | 6.09 | 58 | | 5.58 | 57 | | 16.10 | 43 | | 22.31 | 17 | | 4 | |
| 5 | 22.39 | +17 | | 16.00 | +45 | | 5.46 | +58 | | 6.21 | +57 | | 16.27 | +42 | | 22.38 | +16 | | 5 | |
| 6 | 22.32 | 18 | | 15.41 | 46 | | 5.22 | 58 | | 6.44 | 56 | | 16.44 | 42 | | 22.44 | 15 | | 6 | |
| 7 | 22.24 | 19 | | 15.23 | 47 | | 4.59 | 58 | | 7.06 | 56 | | 17.01 | 41 | | 22.49 | 14 | | 7 | |
| 8 | 22.17 | 20 | | 15.04 | 47 | | 4.35 | 59 | | 7.28 | 56 | | 17.17 | 40 | | 22.55 | 13 | | 8 | |
| 9 | 22.08 | 21 | | 14.45 | 48 | | 4.12 | 59 | | 7.51 | 55 | | 17.33 | 39 | | 23.00 | 12 | | 9 | |
| 10 | 22.00 | +22 | | 14.25 | +49 | | 3.49 | +59 | | 8.13 | +55 | | 17.48 | +39 | | 23.04 | +11 | | 10 | |
| 11 | 21.51 | 23 | | 14.06 | 49 | | 3.25 | 59 | | 8.35 | 55 | | 18.04 | 38 | | 23.08 | 10 | | 11 | |
| 12 | 21.41 | 24 | | 13.46 | 50 | | 3.01 | 59 | | 8.57 | 54 | | 18.19 | 37 | | 23.12 | 9 | | 12 | |
| 13 | 21.31 | 25 | | 13.26 | 50 | | 2.38 | 59 | | 9.18 | 54 | | 18.23 | 36 | | 23.15 | 8 | | 13 | |
| 14 | 21.21 | 26 | | 13.06 | 51 | | 2.14 | 59 | | 9.40 | 54 | | 18.48 | 36 | | 23.18 | 7 | | 14 | |
| 15 | 21.10 | +27 | | 12.45 | +51 | | 1.50 | +59 | | 10.01 | +53 | | 19.02 | +35 | | 23.21 | +6 | | 15 | |
| 16 | 20.59 | 28 | | 12.25 | 52 | | 1.27 | 59 | | 10.23 | 53 | | 19.16 | 34 | | 23.23 | 5 | | 16 | |
| 17 | 20.47 | 29 | | 12.04 | 52 | | 1.03 | 59 | | 10.44 | 52 | | 19.29 | 33 | | 23.25 | 4 | | 17 | |
| 18 | 20.35 | 30 | | 11.43 | 53 | | 0.39 | 59 | | 11.05 | 52 | | 19.42 | 32 | | 23.25 | 3 | | 18 | |
| 19 | 20.23 | 31 | | 11.21 | 53 | | 0.16 | 59 | | 11.25 | 51 | | 19.55 | 31 | | 23.27 | 2 | | 19 | |
| 20 | 20.10 | +32 | | 11.00 | +54 | | 0.08 | +59 | | 11.46 | +51 | | 20.08 | +31 | | 23.27 | +0 | | 20 | |
| 21 | 19.57 | 33 | | 10.38 | 54 | | 0.32 | 59 | | 12.06 | 50 | | 20.20 | 30 | | 23.27 | -0 | | 21 | |
| 22 | 19.44 | 34 | | 10.17 | 54 | | 0.55 | 59 | | 12.26 | 50 | | 20.32 | 29 | | 23.27 | 1 | | 22 | |
| 23 | 19.30 | 35 | | 9.55 | 54 | | 1.19 | 59 | | 12.46 | 49 | | 20.43 | 28 | | 23.26 | 2 | | 23 | |
| 24 | 19.16 | 35 | | 9.33 | 55 | | 1.43 | 59 | | 13.06 | 49 | | 20.54 | 27 | | 23.25 | 4 | | 24 | |
| 25 | 19.01 | +37 | | 9.11 | +56 | | 2.06 | +59 | | 13.25 | +48 | | 21.05 | +26 | | 23.23 | -5 | | 25 | |
| 26 | 18.46 | 38 | | 8.48 | 57 | | 2.30 | 59 | | 13.45 | 48 | | 21.15 | 25 | | 23.21 | 6 | | 26 | |
| 27 | 18.31 | 38 | | 8.26 | 57 | | 2.53 | 59 | | 14.04 | 47 | | 21.25 | 24 | | 23.18 | 7 | | 27 | |
| 28 | 18.15 | 39 | | 8.03 | 57 | | 3.16 | 58 | | 14.22 | 47 | | 21.35 | 23 | | 23.15 | 8 | | 28 | |
| 29 | 18.00 | 40 | | 7.41 | 57 | | 3.40 | 58 | | 14.41 | 46 | | 21.44 | 23 | | 23.12 | 9 | | 29 | |
| 30 | 17.43 | +41 | | 7.18 | +57 | | 4.03 | +58 | | 14.59 | +45 | | 21.53 | +22 | | 23.09 | -10 | | 30 | |
| 31 | 17.27 | 41 | | | | | 4.26 | 57 | | 15.17 | 45 | | 22.01 | 21 | | 23.04 | 11 | | 31 | |
| 32 | 17.10 | 42 | | | | | 4.49 | 57 | | | | | 22.09 | 20 | | | | | 32 | |

DECLINATION OF THE SUN FOR THE YEARS 1888, 1892, 1896, 1900.

| Days. | JULY. | | AUG. | | SEPT. | | OCT. | | NOV. | | DEC. | | Days. |
|-------|-------------|-----------------|-------------|-----------------|-------------|--------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------|
| | Dec. North. | Diff. one hour. | Dec. North. | Diff. one hour. | Dec. North. | South. | Dec. South. | Diff. one hour. | Dec. South. | Diff. one hour. | Dec. South. | Diff. one hour. | |
| | ° ' " | | ° ' " | | ° ' " | | ° ' " | | ° ' " | | ° ' " | | |
| 1 | 23.04 | -11 | 17.51 | -38 | 8.02 | -55 | 3.27 | -58 | 14.40 | -48 | 21.56 | -22 | 1 |
| 2 | 23.00 | 12 | 17.36 | 39 | 7.40 | 55 | 3.51 | 58 | 14.59 | 47 | 22.04 | 21 | 2 |
| 3 | 22.55 | 13 | 17.20 | 40 | 7.18 | 55 | 4.14 | 58 | 15.18 | 46 | 22.13 | 20 | 3 |
| 4 | 22.50 | 14 | 17.04 | 40 | 6.56 | 56 | 4.37 | 58 | 15.36 | 46 | 22.21 | 19 | 4 |
| 5 | 22.44 | -15 | 16.48 | -41 | 6.34 | -56 | 5.00 | -58 | 15.54 | -45 | 22.28 | -18 | 5 |
| 6 | 22.38 | 16 | 16.31 | 42 | 6.11 | 56 | 5.23 | 58 | 16.12 | 44 | 22.35 | 17 | 6 |
| 7 | 22.31 | 17 | 16.15 | 42 | 5.49 | 56 | 5.46 | 57 | 16.30 | 44 | 22.42 | 16 | 7 |
| 8 | 22.25 | 18 | 15.57 | 43 | 5.26 | 57 | 6.09 | 57 | 16.47 | 43 | 22.48 | 15 | 8 |
| 9 | 22.17 | 19 | 15.40 | 44 | 5.04 | 57 | 6.32 | 57 | 17.04 | 42 | 22.54 | 14 | 9 |
| 10 | 22.10 | -20 | 15.23 | -44 | 4.41 | -57 | 6.55 | -57 | 17.21 | -42 | 22.59 | -13 | 10 |
| 11 | 22.02 | 20 | 15.05 | 45 | 4.18 | 57 | 7.17 | 56 | 17.38 | 41 | 23.04 | 11 | 11 |
| 12 | 21.53 | 21 | 14.47 | 45 | 3.55 | 57 | 7.40 | 56 | 17.54 | 40 | 23.09 | 10 | 12 |
| 13 | 21.44 | 22 | 14.28 | 46 | 3.32 | 58 | 8.02 | 56 | 18.10 | 39 | 23.12 | 9 | 13 |
| 14 | 21.35 | 23 | 14.10 | 47 | 3.09 | 58 | 8.25 | 56 | 18.25 | 38 | 23.16 | 8 | 14 |
| 15 | 21.26 | -24 | 13.51 | -47 | 2.46 | -58 | 8.47 | -55 | 18.41 | -38 | 23.19 | -7 | 15 |
| 16 | 21.16 | 25 | 13.32 | 48 | 2.23 | 58 | 9.09 | 55 | 18.56 | 37 | 23.21 | 6 | 16 |
| 17 | 21.06 | 26 | 13.13 | 48 | 1.59 | 58 | 9.10 | 55 | 19.10 | 36 | 23.24 | 5 | 17 |
| 18 | 20.55 | 27 | 12.53 | 49 | 1.36 | 58 | 9.53 | 54 | 19.24 | 35 | 23.25 | 3 | 18 |
| 19 | 20.44 | 28 | 12.34 | 49 | 1.13 | 58 | 10.14 | 54 | 19.38 | 34 | 23.26 | 2 | 19 |
| 20 | 20.33 | -29 | 12.14 | -50 | 0.50 | -58 | 10.36 | -54 | 19.52 | -33 | 23.27 | -1 | 20 |
| 21 | 20.21 | 29 | 11.54 | 50 | 0.26 | 58 | 10.57 | 53 | 20.05 | 32 | 23.27 | +0 | 21 |
| 22 | 20.09 | 30 | 11.34 | 51 | 0.03 | 58 | 11.18 | 53 | 20.18 | 31 | 23.27 | 1 | 22 |
| 23 | 19.57 | 31 | 11.13 | 51 | 0.20 | 58 | 11.39 | 52 | 20.30 | 31 | 23.26 | 2 | 23 |
| 24 | 19.44 | 32 | 10.53 | 52 | 0.44 | 58 | 12.00 | 52 | 20.42 | 30 | 23.25 | 4 | 24 |
| 25 | 19.31 | -33 | 10.32 | -52 | 1.07 | -58 | 12.21 | -51 | 20.64 | -29 | 23.23 | +5 | 25 |
| 26 | 19.18 | 34 | 10.11 | 52 | 1.31 | 58 | 12.41 | 51 | 21.05 | 28 | 23.21 | 6 | 26 |
| 27 | 19.04 | 34 | 9.50 | 53 | 1.54 | 58 | 13.02 | 50 | 21.16 | 27 | 23.18 | 7 | 27 |
| 28 | 18.50 | 35 | 9.29 | 53 | 2.17 | 58 | 13.22 | 50 | 21.27 | 26 | 23.15 | 8 | 28 |
| 29 | 18.36 | 36 | 9.07 | 54 | 2.41 | 58 | 13.42 | 49 | 21.37 | 25 | 23.12 | 9 | 29 |
| 30 | 18.21 | -37 | 8.46 | -54 | 3.04 | -58 | 14.01 | -49 | 21.46 | -24 | 23.07 | +11 | 30 |
| 31 | 18.07 | 37 | 8.24 | 54 | 3.27 | 58 | 14.21 | 48 | 21.56 | 23 | 23.03 | 11 | 31 |
| 32 | 17.51 | 38 | 8.02 | 55 | | | 14.40 | 48 | | | 22.58 | 13 | 32 |

DECLINATION OF THE SUN FOR THE YEARS 1889, 1893, 1897, 1901.

| Days. | JAN. | | FEB. | | MARCH. | | APRIL. | | MAY. | | JUNE. | | Days. |
|-------|-------|-----------------|-------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|-------|-----------------|-------|
| | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | Dec. | Diff. one hour. | |
| | ° ' " | | ° ' " | | ° ' " | | ° ' " | | ° ' " | | ° ' " | | |
| 1 | 22.58 | +13 | 16.57 | +43 | 7.23 | +57 | 4.44 | +58 | 15.13 | +45 | 22.07 | +20 | 1 |
| 2 | 22.53 | 14 | 16.40 | 44 | 7.00 | 57 | 5.07 | 57 | 15.31 | 44 | 22.15 | 19 | 2 |
| 3 | 22.47 | 15 | 16.22 | 44 | 6.37 | 58 | 5.30 | 57 | 15.49 | 44 | 22.22 | 18 | 3 |
| 4 | 22.40 | 16 | 16.04 | 45 | 6.14 | 58 | 5.53 | 57 | 16.06 | 43 | 22.30 | 17 | 4 |
| 5 | 22.34 | +17 | 15.46 | +46 | 5.51 | +58 | 6.15 | +57 | 16.23 | +42 | 22.36 | +16 | 5 |
| 6 | 22.26 | 19 | 15.27 | 47 | 5.28 | 58 | 6.38 | 56 | 16.40 | 42 | 22.42 | 15 | 6 |
| 7 | 22.19 | 20 | 15.08 | 47 | 5.05 | 58 | 7.01 | 56 | 16.57 | 41 | 22.48 | 14 | 7 |
| 8 | 22.11 | 21 | 14.49 | 48 | 4.41 | 58 | 7.23 | 56 | 17.13 | 40 | 22.54 | 13 | 8 |
| 9 | 22.02 | 22 | 14.30 | 48 | 4.18 | 59 | 7.45 | 56 | 17.29 | 40 | 22.59 | 12 | 9 |
| 10 | 21.53 | +23 | 14.11 | +49 | 3.54 | +59 | 8.08 | +55 | 17.45 | +39 | 23.03 | +11 | 10 |
| 11 | 21.44 | 24 | 13.51 | 50 | 3.31 | 59 | 8.30 | 55 | 18.00 | 38 | 23.07 | 10 | 11 |
| 12 | 21.34 | 25 | 13.31 | 50 | 3.07 | 59 | 8.51 | 54 | 18.15 | 37 | 23.11 | 9 | 12 |
| 13 | 21.24 | 26 | 13.11 | 51 | 2.43 | 59 | 9.13 | 54 | 18.30 | 37 | 23.15 | 8 | 13 |
| 14 | 21.13 | 27 | 12.50 | 51 | 2.20 | 59 | 9.35 | 54 | 18.44 | 36 | 23.18 | 7 | 14 |
| 15 | 21.02 | +28 | 12.30 | +52 | 1.56 | +59 | 9.56 | +53 | 18.59 | +35 | 23.20 | +6 | 15 |
| 16 | 20.50 | 29 | 12.09 | 52 | 1.32 | 59 | 10.17 | 53 | 19.12 | 31 | 23.22 | 5 | 16 |
| 17 | 20.38 | 30 | 11.48 | 53 | 1.09 | 59 | 10.39 | 52 | 19.26 | 33 | 23.24 | 4 | 17 |
| 18 | 20.26 | 31 | 11.27 | 53 | 0.45 | 59 | 10.59 | 52 | 19.39 | 33 | 23.26 | 3 | 18 |
| 19 | 20.14 | 32 | 11.05 | 54 | 0.21 | 59 | 11.20 | 52 | 19.52 | 32 | 23.26 | 2 | 19 |
| 20 | 20.01 | +33 | 10.44 | +54 | 0.02 | +59 | 11.41 | +51 | 20.05 | +31 | 23.27 | +1 | 20 |
| 21 | 19.47 | 34 | 10.22 | 54 | 0.26 | 59 | 12.01 | 51 | 20.17 | 30 | 23.27 | -0 | 21 |
| 22 | 19.33 | 35 | 10.00 | 55 | 0.49 | 59 | 12.21 | 50 | 20.29 | 29 | 23.27 | 1 | 22 |
| 23 | 19.19 | 36 | 9.38 | 55 | 1.13 | 59 | 12.41 | 50 | 20.40 | 28 | 23.26 | 2 | 23 |
| 24 | 19.05 | 37 | 9.16 | 56 | 1.37 | 59 | 13.01 | 49 | 20.51 | 27 | 23.25 | 3 | 24 |
| 25 | 18.50 | +37 | 8.54 | +56 | 2.00 | +59 | 13.21 | +49 | 21.02 | +26 | 23.23 | -4 | 25 |
| 26 | 18.35 | 38 | 8.31 | 56 | 2.24 | 59 | 13.40 | 48 | 21.12 | 26 | 23.21 | 5 | 26 |
| 27 | 18.19 | 39 | 8.09 | 57 | 2.47 | 59 | 13.59 | 47 | 21.23 | 25 | 23.19 | 6 | 27 |
| 28 | 18.03 | 40 | 7.46 | 57 | 3.11 | 58 | 14.18 | 47 | 21.32 | 24 | 23.16 | 7 | 28 |
| 29 | 17.47 | 41 | 7.23 | 57 | 3.34 | 58 | 14.36 | 46 | 21.42 | 23 | 23.13 | 8 | 29 |
| 30 | 17.31 | +42 | | | 3.57 | +58 | 14.55 | +46 | 21.51 | +22 | 23.09 | -9 | 30 |
| 31 | 17.14 | 42 | | | 4.21 | 58 | 15.13 | 45 | 21.59 | 21 | 23.05 | 10 | 31 |
| 32 | 16.57 | 43 | | | 4.44 | 58 | | | 22.07 | 20 | | | 32 |

DECLINATION OF THE SUN FOR THE YEARS 1889, 1893, 1897, 1901.

| Days. | JULY. | | | AUG. | | | SEPT. | | | OCT. | | | Nov. | | | DEC. | | | Days. |
|-------|-------------|---|----------------|-------------|---|-----------------|-------------------|---|-----------------|-------------|---|-----------------|-------------|---|-----------------|-------------|---|-----------------|-------|
| | Dec. North. | | Diff. one hour | Dec. North. | | Diff. one hour. | Dec. North South. | | Diff. one hour. | Dec. South. | | Diff. one hour. | Dec. South. | | Diff. one hour. | Dec. South. | | Diff. one hour. | |
| | ° | ' | | ° | ' | | ° | ' | | ° | ' | | ° | ' | | ° | ' | | |
| 1 | 23.06 | | -11 | 17.55 | | -38 | 8.07 | | -55 | 3.22 | | -58 | 14.35 | | -48 | 21.54 | | -23 | 1 |
| 2 | 23.01 | | 12 | 17.40 | | 39 | 7.46 | | 55 | 3.45 | | 58 | 14.54 | | 47 | 22.02 | | 22 | 2 |
| 3 | 22.56 | | 13 | 17.24 | | 39 | 7.24 | | 55 | 4.08 | | 58 | 15.13 | | 47 | 22.11 | | 21 | 3 |
| 4 | 22.51 | | 16 | 17.08 | | 40 | 7.01 | | 55 | 4.31 | | 58 | 15.32 | | 46 | 22.19 | | 20 | 4 |
| 5 | 22.45 | | -15 | 16.52 | | -41 | 6.39 | | -56 | 4.55 | | -58 | 15.50 | | -45 | 22.27 | | -18 | 5 |
| 6 | 22.39 | | 16 | 16.35 | | 41 | 6.17 | | 56 | 5.18 | | 57 | 16.08 | | 45 | 22.34 | | 17 | 6 |
| 7 | 22.33 | | 17 | 16.19 | | 42 | 5.54 | | 56 | 5.41 | | 57 | 16.26 | | 44 | 22.41 | | 16 | 7 |
| 8 | 22.26 | | 18 | 16.01 | | 43 | 5.32 | | 56 | 6.04 | | 57 | 16.43 | | 43 | 22.47 | | 15 | 8 |
| 9 | 22.19 | | 19 | 15.44 | | 43 | 5.09 | | 57 | 6.26 | | 57 | 17.00 | | 43 | 22.53 | | 14 | 9 |
| 10 | 22.12 | | -20 | 15.27 | | -44 | 4.46 | | -57 | 6.49 | | -57 | 17.17 | | -42 | 22.58 | | -13 | 10 |
| 11 | 22.04 | | 20 | 15.09 | | 45 | 4.23 | | 57 | 7.12 | | 56 | 17.34 | | 41 | 23.03 | | 12 | 11 |
| 12 | 21.55 | | 21 | 14.51 | | 45 | 4.01 | | 57 | 7.34 | | 56 | 17.50 | | 40 | 23.07 | | 11 | 12 |
| 13 | 21.47 | | 22 | 14.33 | | 46 | 3.38 | | 57 | 7.57 | | 56 | 18.06 | | 39 | 23.12 | | 10 | 13 |
| 14 | 21.38 | | 23 | 14.14 | | 46 | 3.15 | | 58 | 8.19 | | 56 | 18.22 | | 39 | 23.15 | | 8 | 14 |
| 15 | 21.28 | | -24 | 13.54 | | -47 | 2.51 | | -58 | 8.41 | | -55 | 18.37 | | -38 | 23.18 | | -7 | 15 |
| 16 | 21.18 | | 25 | 13.37 | | 48 | 2.28 | | 58 | 9.04 | | 55 | 18.52 | | 37 | 23.21 | | 6 | 16 |
| 17 | 21.08 | | 26 | 13.17 | | 48 | 2.05 | | 58 | 9.26 | | 55 | 19.07 | | 36 | 23.23 | | 5 | 17 |
| 18 | 20.58 | | 27 | 12.58 | | 49 | 1.42 | | 58 | 9.47 | | 54 | 19.21 | | 35 | 23.25 | | 4 | 18 |
| 19 | 20.47 | | 28 | 12.38 | | 49 | 1.19 | | 58 | 10.09 | | 54 | 19.35 | | 34 | 23.26 | | 2 | 19 |
| 20 | 20.36 | | -28 | 12.19 | | -50 | 0.55 | | -58 | 10.31 | | -54 | 19.49 | | -34 | 23.27 | | -1 | 20 |
| 21 | 20.24 | | 29 | 11.59 | | 50 | 0.32 | | 58 | 10.52 | | 53 | 20.02 | | 33 | 23.27 | | 0 | 21 |
| 22 | 20.12 | | 30 | 11.39 | | 51 | 0.08 | | 58 | 11.13 | | 53 | 20.15 | | 32 | 23.27 | | +1 | 22 |
| 23 | 20.00 | | 31 | 11.18 | | 51 | 0.15 | | 58 | 11.34 | | 52 | 20.27 | | 31 | 23.26 | | 2 | 23 |
| 24 | 19.47 | | 31 | 10.58 | | 51 | 0.38 | | 58 | 11.55 | | 52 | 20.40 | | 30 | 23.25 | | 3 | 24 |
| 25 | 19.34 | | -33 | 10.37 | | -52 | 1.02 | | -58 | 12.16 | | -51 | 20.51 | | -29 | 23.24 | | +5 | 25 |
| 26 | 19.21 | | 33 | 10.16 | | 52 | 1.25 | | 58 | 12.37 | | 51 | 21.03 | | 28 | 23.22 | | 6 | 26 |
| 27 | 19.08 | | 34 | 9.55 | | 53 | 1.48 | | 58 | 12.57 | | 51 | 21.14 | | 27 | 23.19 | | 7 | 27 |
| 28 | 18.54 | | 35 | 9.34 | | 53 | 2.12 | | 58 | 13.17 | | 50 | 21.24 | | 26 | 23.16 | | 8 | 28 |
| 29 | 18.39 | | 36 | 9.12 | | 53 | 2.35 | | 58 | 13.37 | | 49 | 21.34 | | 25 | 23.12 | | 9 | 29 |
| 30 | 18.25 | | -37 | 8.51 | | -54 | 2.58 | | -58 | 13.57 | | -49 | 21.44 | | -24 | 23.09 | | +10 | 30 |
| 31 | 18.10 | | 37 | 8.29 | | 54 | 3.27 | | 58 | 14.16 | | 48 | 21.53 | | 23 | 23.04 | | 12 | 31 |
| 32 | 17.55 | | 38 | 8.08 | | 55 | | | | 14.35 | | 48 | | | | 22.59 | | 13 | 32 |



TABLE IV.
EQUATION OF TIME,
1886-1901.

EQUATION OF TIME FOR THE YEARS 1886, 1890, 1894, 1898.

| Days. | JAN. | FEB. | MAR. | APR. | MAY. | JUNE. | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. |
|-------|----------------------|----------------------|----------------------|-----------------------------------|-------------------------|-----------------------------------|----------------------|----------------------|-------------------------|-------------------------|-------------------------|-----------------------------------|
| | Add to app. time. | Add to app. time. | Add to app. time. | Add to Sub. from app. time. | Sub. from app. time. | Sub. from Add to app. time. | Add to app. time. | Add to app. time. | Sub. from app. time. | Sub. from app. time. | Sub. from app. time. | Sub. from Add to app. time. |
| M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. |
| 1 | 3 53 | 13 51 | 12 30 | 3 54 | 3 02 | 2 27 | 3 33 | 6 05 | 0 08 | 10 21 | 16 18 | 10 44 |
| 2 | 4 21 | 13 58 | 12 18 | 3 36 | 3 10 | 2 18 | 3 44 | 6 01 | 0 27 | 10 40 | 16 18 | 10 21 |
| 3 | 4 49 | 14 05 | 12 05 | 3 18 | 3 16 | 2 08 | 3 55 | 5 57 | 0 46 | 10 58 | 16 18 | 9 58 |
| 4 | 5 16 | 14 10 | 11 52 | 3 00 | 3 22 | 1 58 | 4 06 | 5 52 | 1 05 | 11 17 | 16 18 | 9 33 |
| 5 | 5 43 | 14 15 | 11 38 | 2 43 | 3 27 | 1 47 | 4 17 | 5 46 | 1 25 | 11 35 | 16 16 | 9 09 |
| 6 | 6 10 | 14 20 | 11 24 | 2 25 | 3 32 | 1 37 | 4 27 | 5 40 | 1 45 | 11 52 | 16 14 | 8 43 |
| 7 | 6 36 | 14 23 | 11 10 | 2 08 | 3 37 | 1 26 | 4 37 | 5 33 | 2 05 | 12 09 | 16 10 | 8 18 |
| 8 | 7 02 | 14 25 | 10 55 | 1 51 | 3 41 | 1 14 | 4 47 | 5 25 | 2 26 | 12 26 | 16 06 | 7 51 |
| 9 | 7 27 | 14 27 | 10 40 | 1 34 | 3 44 | 1 03 | 4 56 | 5 17 | 2 46 | 12 42 | 16 02 | 7 25 |
| 10 | 7 51 | 14 28 | 10 25 | 1 18 | 3 46 | 0 51 | 5 04 | 5 09 | 3 07 | 12 58 | 15 56 | 6 57 |
| 11 | 8 15 | 14 28 | 10 09 | 1 02 | 3 49 | 0 39 | 5 13 | 4 59 | 2 26 | 13 14 | 15 49 | 6 30 |
| 12 | 8 38 | 14 27 | 9 53 | 0 46 | 3 50 | 0 27 | 5 20 | 4 49 | 3 46 | 13 29 | 15 42 | 6 02 |
| 13 | 9 01 | 14 26 | 9 36 | 0 30 | 3 51 | 0 15 | 5 28 | 4 39 | 4 10 | 13 43 | 15 34 | 5 34 |
| 14 | 9 23 | 14 24 | 9 19 | 0 15 | 3 51 | 0 02 | 5 34 | 4 28 | 4 31 | 13 57 | 15 25 | 5 05 |
| 15 | 9 44 | 14 21 | 9 02 | 0 00 | 3 51 | 0 10 | 5 41 | 4 17 | 4 52 | 14 11 | 15 15 | 4 36 |
| 16 | 10 05 | 14 17 | 8 45 | 0 15 | 3 51 | 0 23 | 5 46 | 4 05 | 3 14 | 14 24 | 15 04 | 4 07 |
| 17 | 10 24 | 14 13 | 8 27 | 0 29 | 3 49 | 0 36 | 5 52 | 3 52 | 5 35 | 14 36 | 14 52 | 3 38 |
| 18 | 10 44 | 14 07 | 8 10 | 0 43 | 3 48 | 0 49 | 5 57 | 3 39 | 5 56 | 14 47 | 14 40 | 3 08 |
| 19 | 11 02 | 14 02 | 7 52 | 0 57 | 3 45 | 1 02 | 6 01 | 3 26 | 6 17 | 14 58 | 14 26 | 2 38 |
| 20 | 11 20 | 13 55 | 7 34 | 1 10 | 3 42 | 1 14 | 6 04 | 3 12 | 6 38 | 15 09 | 14 12 | 2 09 |
| 21 | 11 37 | 13 48 | 7 15 | 1 22 | 3 39 | 1 27 | 6 08 | 2 57 | 6 59 | 15 18 | 13 57 | 1 39 |
| 22 | 11 53 | 13 40 | 6 57 | 1 35 | 3 35 | 1 40 | 6 10 | 2 42 | 7 20 | 15 27 | 13 41 | 1 09 |
| 23 | 12 08 | 13 32 | 6 39 | 1 47 | 3 30 | 1 53 | 6 12 | 2 27 | 7 41 | 15 36 | 13 24 | 0 38 |
| 24 | 12 23 | 13 23 | 6 20 | 1 58 | 3 25 | 2 06 | 6 14 | 2 11 | 8 02 | 15 43 | 13 07 | 0 08 |
| 25 | 12 36 | 13 13 | 6 02 | 2 09 | 3 20 | 2 19 | 6 15 | 1 55 | 8 22 | 15 50 | 12 49 | 0 22 |
| 26 | 12 49 | 13 03 | 5 43 | 2 19 | 3 14 | 2 32 | 6 15 | 1 39 | 8 43 | 15 56 | 12 30 | 0 51 |
| 27 | 13 02 | 12 53 | 5 25 | 2 29 | 3 07 | 2 44 | 6 15 | 1 22 | 9 03 | 16 02 | 12 10 | 1 21 |
| 28 | 13 13 | 12 42 | 5 07 | 2 38 | 3 00 | 2 57 | 6 14 | 1 04 | 9 23 | 16 07 | 11 50 | 1 51 |
| 29 | 13 24 | 12 30 | 4 48 | 2 47 | 2 52 | 3 09 | 6 13 | 0 47 | 9 42 | 16 10 | 11 29 | 2 20 |
| 30 | 13 33 | | 4 30 | 2 55 | 2 44 | 3 21 | 6 11 | 0 29 | 10 02 | 16 14 | 11 07 | 2 49 |
| 31 | 13 42 | | 4 12 | 3 02 | 2 36 | 3 33 | 6 08 | 0 11 | 10 21 | 16 16 | 10 44 | 3 18 |

EQUATION OF TIME FOR THE YEARS 1887, 1891, 1895, 1899.

| Days. | JAN. | FEB. | MAR. | APR. | MAY. | JUNE. | JULY. | AUG. | SEPT. | OCT. | NOV. | DEC. |
|-------|----------------------|----------------------|----------------------|-----------------------------------|-------------------------|-----------------------------------|----------------------|----------------------|-------------------------|-------------------------|-------------------------|-----------------------------------|
| | Add to app. time. | Add to app. time. | Add to app. time. | Add to Sub. from app. time. | Sub. from app. time. | Sub. from Add to app. time. | Add to app. time. | Add to app. time. | Sub. from app. time. | Sub. from app. time. | Sub. from app. time. | Sub. from Add to app. time. |
| M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. | M. S. |
| 1 | 3 47 | 13 49 | 12 33 | 3 59 | 3 00 | 2 28 | 3 30 | 6 06 | 0 04 | 10 17 | 16 18 | 10 51 |
| 2 | 4 15 | 13 57 | 12 21 | 3 41 | 3 07 | 2 19 | 3 42 | 6 02 | 0 23 | 10 36 | 16 20 | 10 28 |
| 3 | 4 43 | 14 04 | 12 09 | 3 23 | 3 14 | 2 10 | 3 53 | 5 58 | 0 42 | 10 55 | 16 20 | 10 04 |
| 4 | 5 10 | 14 09 | 11 56 | 3 05 | 3 20 | 2 00 | 4 04 | 5 52 | 1 02 | 11 13 | 16 19 | 9 40 |
| 5 | 5 37 | 14 14 | 11 42 | 2 47 | 3 26 | 1 50 | 4 14 | 5 47 | 1 21 | 11 32 | 16 18 | 9 16 |
| 6 | 6 04 | 14 18 | 11 28 | 2 29 | 3 31 | 1 39 | 4 25 | 5 41 | 1 41 | 11 49 | 16 16 | 8 51 |
| 7 | 6 30 | 14 22 | 11 14 | 2 12 | 3 36 | 1 29 | 4 34 | 5 34 | 2 02 | 12 07 | 16 13 | 8 25 |
| 8 | 6 55 | 14 24 | 10 59 | 1 55 | 3 40 | 1 17 | 4 44 | 5 26 | 2 22 | 12 23 | 16 09 | 7 59 |
| 9 | 7 20 | 14 26 | 10 44 | 1 38 | 3 43 | 1 06 | 4 53 | 5 18 | 2 42 | 12 40 | 16 04 | 7 32 |
| 10 | 7 45 | 14 27 | 10 28 | 1 21 | 3 46 | 0 54 | 5 02 | 5 10 | 3 03 | 12 56 | 15 58 | 7 05 |
| 11 | 8 09 | 14 27 | 10 12 | 1 05 | 3 48 | 0 43 | 5 10 | 5 01 | 3 24 | 13 11 | 15 52 | 6 37 |
| 12 | 8 32 | 14 27 | 9 56 | 0 49 | 3 50 | 0 30 | 5 18 | 4 51 | 3 45 | 13 26 | 15 45 | 6 09 |
| 13 | 8 55 | 14 25 | 9 39 | 0 33 | 3 51 | 0 18 | 5 25 | 4 41 | 4 06 | 13 41 | 15 36 | 5 41 |
| 14 | 9 17 | 14 23 | 9 23 | 0 18 | 3 52 | 0 06 | 5 32 | 4 30 | 4 27 | 13 55 | 15 27 | 5 12 |
| 15 | 9 38 | 14 21 | 9 06 | 0 03 | 3 52 | 0 07 | 5 39 | 4 19 | 4 48 | 14 08 | 15 17 | 4 43 |
| 16 | 9 59 | 14 17 | 8 48 | 0 12 | 3 51 | 0 20 | 5 45 | 4 07 | 5 09 | 14 22 | 15 07 | 4 14 |
| 17 | 10 19 | 14 13 | 8 31 | 0 26 | 3 50 | 0 33 | 5 50 | 3 55 | 5 30 | 14 33 | 14 55 | 3 44 |
| 18 | 10 38 | 14 08 | 8 13 | 0 40 | 3 48 | 0 46 | 5 56 | 3 42 | 5 51 | 14 45 | 14 43 | 3 14 |
| 19 | 10 57 | 14 03 | 7 56 | 0 53 | 3 46 | 0 59 | 6 00 | 3 29 | 6 12 | 14 56 | 14 29 | 2 45 |
| 20 | 11 15 | 13 57 | 7 38 | 1 07 | 3 43 | 1 12 | 6 04 | 3 15 | 6 33 | 15 06 | 14 15 | 2 15 |
| 21 | 11 32 | 13 50 | 7 20 | 1 19 | 3 39 | 1 25 | 6 07 | 3 01 | 6 54 | 15 16 | 14 00 | 1 45 |
| 22 | 11 49 | 13 42 | 7 02 | 1 31 | 3 35 | 1 38 | 6 10 | 2 46 | 7 15 | 15 25 | 13 45 | 1 15 |
| 23 | 12 04 | 13 34 | 6 43 | 1 43 | 3 31 | 1 51 | 6 13 | 2 31 | 7 36 | 15 34 | 13 28 | 0 45 |
| 24 | 12 19 | 13 26 | 6 25 | 1 54 | 3 26 | 2 04 | 6 14 | 2 15 | 7 57 | 15 42 | 13 11 | 0 15 |
| 25 | 12 33 | 13 16 | 6 07 | 2 05 | 3 20 | 2 17 | 6 15 | 2 00 | 8 17 | 15 49 | 12 53 | 0 15 |
| 26 | 12 47 | 13 06 | 5 49 | 2 16 | 3 14 | 2 30 | 6 16 | 1 43 | 8 38 | 15 55 | 12 34 | 0 45 |
| 27 | 12 59 | 12 56 | 5 30 | 2 25 | 3 08 | 2 42 | 6 16 | 1 26 | 8 58 | 16 01 | 12 15 | 1 14 |
| 28 | 13 11 | 12 45 | 5 12 | 2 35 | 3 01 | 2 55 | 6 15 | 1 09 | 9 18 | 16 06 | 11 55 | 1 44 |
| 29 | 13 22 | 12 33 | 4 53 | 2 44 | 2 53 | 3 07 | 6 14 | 0 51 | 9 38 | 16 10 | 11 34 | 2 13 |
| 30 | 13 32 | | 4 35 | 2 52 | 2 45 | 3 19 | 6 12 | 0 33 | 9 58 | 16 14 | 11 13 | 2 42 |
| 31 | 13 41 | | 4 17 | 2 60 | 2 37 | 3 30 | 6 09 | 0 15 | 10 17 | 16 16 | 10 51 | 3 11 |

EQUATION OF TIME FOR THE YEARS 1888, 1892, 1896, 1900.

| Days. | JAN. | FEB. | MAR. | APR. | MAY. | JUNE. | JULY. | AUG. | SEPT. | OCT. | NOV. | DEC. |
|-------|-------------------------------|-------------------------------|-------------------------------|--|----------------------------------|--|-------------------------------|--|----------------------------------|----------------------------------|----------------------------------|--|
| | Add to app. time. M. S. | Add to app. time. M. S. | Add to app. time. M. S. | Add to Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from Add to app. time. M. S. | Add to app. time. M. S. | Add to Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from Add to app. time. M. S. |
| 1 | 3 40 | 13 48 | 12 25 | 3 45 | 3 05 | 2 22 | 3 38 | 6 02 | 0 19 | 10 33 | 16 20 | 10 34 |
| 2 | 4 08 | 13 55 | 12 12 | 3 27 | 3 12 | 2 12 | 3 50 | 5 58 | 0 38 | 10 52 | 16 21 | 10 11 |
| 3 | 4 36 | 14 02 | 11 59 | 3 10 | 3 18 | 2 02 | 4 01 | 5 53 | 0 58 | 11 10 | 16 20 | 9 47 |
| 4 | 5 03 | 14 08 | 11 46 | 2 52 | 3 24 | 1 52 | 4 12 | 5 48 | 1 17 | 11 28 | 16 19 | 9 22 |
| 5 | 5 30 | 14 14 | 11 32 | 2 34 | 3 29 | 1 42 | 4 22 | 5 42 | 1 37 | 11 46 | 16 17 | 8 57 |
| 6 | 5 57 | 14 18 | 11 18 | 2 17 | 3 34 | 1 31 | 4 32 | 5 35 | 1 57 | 12 03 | 16 14 | 8 31 |
| 7 | 6 23 | 14 22 | 11 03 | 2 00 | 3 38 | 1 20 | 4 42 | 5 28 | 2 17 | 12 20 | 16 10 | 8 05 |
| 8 | 6 49 | 14 25 | 10 48 | 1 43 | 3 42 | 1 08 | 4 51 | 5 20 | 2 37 | 12 36 | 16 06 | 7 38 |
| 9 | 7 14 | 14 27 | 10 33 | 1 27 | 3 45 | 0 56 | 5 00 | 5 12 | 2 58 | 12 52 | 16 00 | 7 11 |
| 10 | 7 39 | 14 28 | 10 17 | 1 10 | 3 47 | 0 45 | 5 09 | 5 03 | 3 19 | 13 08 | 15 54 | 6 44 |
| 11 | 8 03 | 14 29 | 10 01 | 0 54 | 3 49 | 0 32 | 5 17 | 4 54 | 3 40 | 13 23 | 15 47 | 6 16 |
| 12 | 8 27 | 14 29 | 9 45 | 0 39 | 3 50 | 0 20 | 5 24 | 4 44 | 4 01 | 13 38 | 15 39 | 5 48 |
| 13 | 8 50 | 14 28 | 9 28 | 0 23 | 3 50 | 0 07 | 5 31 | 4 33 | 4 22 | 13 52 | 15 30 | 5 19 |
| 14 | 9 13 | 14 26 | 9 12 | 0 08 | 3 50 | 0 05 | 5 38 | 4 22 | 4 23 | 14 05 | 15 21 | 4 50 |
| 15 | 9 34 | 14 23 | 8 55 | 0 06 | 3 50 | 0 18 | 5 44 | 4 10 | 5 04 | 14 19 | 15 10 | 4 21 |
| 16 | 9 55 | 14 20 | 8 37 | 0 21 | 3 49 | 0 31 | 5 50 | 3 58 | 5 25 | 14 31 | 14 59 | 3 52 |
| 17 | 10 16 | 14 16 | 8 20 | 0 35 | 3 47 | 0 44 | 5 55 | 3 45 | 5 47 | 14 43 | 14 47 | 3 23 |
| 18 | 10 35 | 14 12 | 8 02 | 0 48 | 3 45 | 0 57 | 5 59 | 3 32 | 6 08 | 14 54 | 14 34 | 2 53 |
| 19 | 10 54 | 14 06 | 7 44 | 1 02 | 3 42 | 1 10 | 6 03 | 3 18 | 6 29 | 15 05 | 14 20 | 2 23 |
| 20 | 11 12 | 14 00 | 7 26 | 1 15 | 3 39 | 1 22 | 6 07 | 3 04 | 6 50 | 15 15 | 14 06 | 1 54 |
| 21 | 11 30 | 13 53 | 7 08 | 1 27 | 3 35 | 1 35 | 6 10 | 2 49 | 7 11 | 15 25 | 13 50 | 1 24 |
| 22 | 11 46 | 13 46 | 6 50 | 1 39 | 3 31 | 1 48 | 6 12 | 2 34 | 7 32 | 15 33 | 13 34 | 0 54 |
| 23 | 12 02 | 13 38 | 6 31 | 1 50 | 3 26 | 2 01 | 6 13 | 2 18 | 7 53 | 15 42 | 13 17 | 0 24 |
| 24 | 12 17 | 13 29 | 6 13 | 2 02 | 3 21 | 2 14 | 6 14 | 2 02 | 8 14 | 15 49 | 12 59 | 0 06 |
| 25 | 12 31 | 13 20 | 5 54 | 2 12 | 3 15 | 2 26 | 6 15 | 1 46 | 8 34 | 15 56 | 12 41 | 0 36 |
| 26 | 12 45 | 13 10 | 5 36 | 2 22 | 3 09 | 2 39 | 6 15 | 1 29 | 8 55 | 16 01 | 12 22 | 1 06 |
| 27 | 12 57 | 13 00 | 5 17 | 2 32 | 3 02 | 2 51 | 6 14 | 1 12 | 9 15 | 16 07 | 12 02 | 1 35 |
| 28 | 13 09 | 12 49 | 4 59 | 2 41 | 2 55 | 3 03 | 6 13 | 0 54 | 9 35 | 16 11 | 11 41 | 2 05 |
| 29 | 13 20 | 12 37 | 4 40 | 2 50 | 2 47 | 3 15 | 6 11 | 0 36 | 9 54 | 16 15 | 11 19 | 2 34 |
| 30 | 13 30 | 12 25 | 4 22 | 2 58 | 2 39 | 3 27 | 6 09 | 0 18 | 10 14 | 16 17 | 10 57 | 3 03 |
| 31 | 13 39 | | 4 04 | 3 05 | 2 31 | 3 38 | 6 06 | 0 00 | 10 33 | 16 19 | 10 34 | 3 32 |

EQUATION OF TIME FOR THE YEARS 1889, 1893, 1897, 1901.

| Days. | JAN. | FEB. | MAR. | APR. | MAY. | JUNE. | JULY. | AUG. | SEPT. | OCT. | NOV. | DEC. |
|-------|-------------------------------|-------------------------------|-------------------------------|--|----------------------------------|--|-------------------------------|-------------------------------|----------------------------------|----------------------------------|----------------------------------|--|
| | Add to app. time. M. S. | Add to app. time. M. S. | Add to app. time. M. S. | Add to Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from Add to app. time. M. S. | Add to app. time. M. S. | Add to app. time. M. S. | Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from app. time. M. S. | Sub. from Add to app. time. M. S. |
| 1 | 4 01 | 13 54 | 12 28 | 3 50 | 3 03 | 2 24 | 3 36 | 6 04 | 0 13 | 10 27 | 16 19 | 10 39 |
| 2 | 4 29 | 14 01 | 12 16 | 3 32 | 3 10 | 2 14 | 3 48 | 6 00 | 0 32 | 10 46 | 16 20 | 10 16 |
| 3 | 4 56 | 14 07 | 12 03 | 3 14 | 3 17 | 2 04 | 3 59 | 5 55 | 0 52 | 11 04 | 16 20 | 9 52 |
| 4 | 5 24 | 14 13 | 11 50 | 2 57 | 3 23 | 1 54 | 4 10 | 5 50 | 1 11 | 11 22 | 16 19 | 9 28 |
| 5 | 5 51 | 14 18 | 11 36 | 2 39 | 3 28 | 1 44 | 4 20 | 5 44 | 1 31 | 11 40 | 16 17 | 9 03 |
| 6 | 6 17 | 14 22 | 11 22 | 2 22 | 3 33 | 1 33 | 4 30 | 5 38 | 1 51 | 11 58 | 16 14 | 8 38 |
| 7 | 6 43 | 14 25 | 11 08 | 2 05 | 3 37 | 1 22 | 4 40 | 5 31 | 2 12 | 12 15 | 16 11 | 8 12 |
| 8 | 7 09 | 14 27 | 10 53 | 1 48 | 3 41 | 1 11 | 4 49 | 5 23 | 2 32 | 12 32 | 16 07 | 7 45 |
| 9 | 7 33 | 14 28 | 10 37 | 1 31 | 3 44 | 0 59 | 4 58 | 5 15 | 2 53 | 12 48 | 16 02 | 7 19 |
| 10 | 7 58 | 14 29 | 10 22 | 1 15 | 3 46 | 0 48 | 5 07 | 5 06 | 3 14 | 13 04 | 15 56 | 6 51 |
| 11 | 8 21 | 14 29 | 10 06 | 0 58 | 3 48 | 0 36 | 5 15 | 4 56 | 3 34 | 13 19 | 15 49 | 6 24 |
| 12 | 8 45 | 14 28 | 9 49 | 0 42 | 3 50 | 0 24 | 5 22 | 4 46 | 3 56 | 13 34 | 15 41 | 5 55 |
| 13 | 9 07 | 14 26 | 9 33 | 0 27 | 3 51 | 0 11 | 5 29 | 4 36 | 4 17 | 13 48 | 15 33 | 5 27 |
| 14 | 9 29 | 14 24 | 9 16 | 0 12 | 3 51 | 0 01 | 5 36 | 4 25 | 4 38 | 14 02 | 15 23 | 4 58 |
| 15 | 9 50 | 14 21 | 8 59 | 0 03 | 3 51 | 0 14 | 5 42 | 4 13 | 4 59 | 14 15 | 15 13 | 4 29 |
| 16 | 10 10 | 14 17 | 8 41 | 0 18 | 3 50 | 0 27 | 5 48 | 4 01 | 5 20 | 14 28 | 15 02 | 4 00 |
| 17 | 10 30 | 14 12 | 8 23 | 0 32 | 3 49 | 0 39 | 5 53 | 3 48 | 5 41 | 14 40 | 14 50 | 3 30 |
| 18 | 10 49 | 14 07 | 8 06 | 0 46 | 3 47 | 0 52 | 5 58 | 3 35 | 6 03 | 14 52 | 14 37 | 3 01 |
| 19 | 11 07 | 14 01 | 7 48 | 1 00 | 3 44 | 1 05 | 6 02 | 3 22 | 6 24 | 15 02 | 14 23 | 2 31 |
| 20 | 11 24 | 13 54 | 7 30 | 1 12 | 3 41 | 1 18 | 6 05 | 3 07 | 6 45 | 15 12 | 14 09 | 2 01 |
| 21 | 11 41 | 13 47 | 7 12 | 1 25 | 3 37 | 1 31 | 6 08 | 2 53 | 7 06 | 15 22 | 13 54 | 1 31 |
| 22 | 11 57 | 13 39 | 6 53 | 1 37 | 3 33 | 1 44 | 6 11 | 2 38 | 7 27 | 15 31 | 13 38 | 1 01 |
| 23 | 12 12 | 13 31 | 6 35 | 1 49 | 3 29 | 1 57 | 6 13 | 2 23 | 7 47 | 15 39 | 13 21 | 0 31 |
| 24 | 12 27 | 13 22 | 6 17 | 2 00 | 3 23 | 2 10 | 6 14 | 2 07 | 8 08 | 15 46 | 13 03 | 0 01 |
| 25 | 12 40 | 13 12 | 5 58 | 2 10 | 3 17 | 2 23 | 6 15 | 1 51 | 8 28 | 15 53 | 12 45 | 0 29 |
| 26 | 12 53 | 13 02 | 5 40 | 2 21 | 3 11 | 2 36 | 6 15 | 1 34 | 8 49 | 15 59 | 12 25 | 0 59 |
| 27 | 13 05 | 12 51 | 5 21 | 2 30 | 3 04 | 2 48 | 6 15 | 1 17 | 9 09 | 16 04 | 12 05 | 1 29 |
| 28 | 13 17 | 12 40 | 5 06 | 2 39 | 2 57 | 3 00 | 6 14 | 1 00 | 9 29 | 16 09 | 11 45 | 1 58 |
| 29 | 13 27 | 12 28 | 4 45 | 2 48 | 2 49 | 3 13 | 6 12 | 0 42 | 9 48 | 16 12 | 11 24 | 2 28 |
| 30 | 13 37 | | 4 26 | 2 56 | 2 41 | 3 25 | 6 10 | 0 24 | 10 08 | 16 15 | 11 02 | 2 57 |
| 31 | 13 46 | | 4 08 | | 2 33 | | 6 07 | 0 05 | | 16 18 | 10 39 | 3 25 |

TABLE IVa.
CORRECTION TO BE APPLIED TO EQUATION OF TIME.

| Hour. | " 1 | " 2 | " 3 | " 4 | " 5 | " 6 | " 7 | " 8 | " 9 | " 10 | " 11 | " 12 | " 13 | " 14 | " 15 | " 16 | " 17 | " 18 | " 19 | " 20 | " 21 | " 22 | " 23 | " 24 | " 25 | " 26 | " 27 | " 28 | " 29 | " 30 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

TABLE V.

SINES, TANGENTS, AND SECANTS.

SINES, TANGENTS, AND SECANTS.

| 179 | | | | | | | | | | | |
|-----|------------|------------|-----------|-----------|-----------|-----------|-----------|------------|----------|----------|----|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. 1'. | Cosecant. | Tangent. | Diff. 1'. | Cotangent. | Secant. | Cosine. | M. |
| 0 | 12 0 0 | 0 0 0 | Inf. neg. | | Infinite. | Inf. neg. | | Infinite. | 10.00000 | 10.00000 | 60 |
| 1 | 11 59 52 | 0 8 | 6.46373 | 30103 | 13.53627 | 6.46373 | 30103 | 13.53627 | 0.00000 | 0.00000 | 59 |
| 2 | 59 44 | 0 16 | 76476 | 17609 | 23524 | 76476 | 17609 | 23524 | 0.00000 | 0.00000 | 58 |
| 3 | 59 36 | 0 24 | 94085 | 12494 | 05915 | 94085 | 12494 | 05915 | 0.00000 | 0.00000 | 57 |
| 4 | 59 28 | 0 32 | 7.06579 | 9691 | 12.93421 | 7.06579 | 9691 | 12.93421 | 0.00000 | 0.00000 | 56 |
| 5 | 11 59 20 | 0 40 | 7.16270 | 7918 | 12.83730 | 7.16270 | 7918 | 12.83730 | 10.00000 | 10.00000 | 55 |
| 6 | 59 12 | 0 48 | 24188 | 6694 | 75812 | 24188 | 6694 | 75812 | 0.00000 | 0.00000 | 54 |
| 7 | 59 4 | 0 56 | 30882 | 5800 | 69118 | 30882 | 5800 | 69118 | 0.00000 | 0.00000 | 53 |
| 8 | 58 56 | 1 4 | 36682 | 5115 | 63318 | 36682 | 5115 | 63318 | 0.00000 | 0.00000 | 52 |
| 9 | 58 48 | 1 12 | 41797 | 4576 | 58203 | 41797 | 4576 | 58203 | 0.00000 | 0.00000 | 51 |
| 10 | 11 58 40 | 0 1 20 | 7.46373 | 4139 | 12.53627 | 7.46373 | 4139 | 12.53627 | 10.00000 | 10.00000 | 50 |
| 11 | 58 32 | 1 28 | 50512 | 3779 | 49488 | 50512 | 3779 | 49488 | 0.00000 | 0.00000 | 49 |
| 12 | 58 24 | 1 36 | 54291 | 3476 | 45709 | 54291 | 3476 | 45709 | 0.00000 | 0.00000 | 48 |
| 13 | 58 16 | 1 44 | 57707 | 3218 | 42233 | 57707 | 3219 | 42233 | 0.00000 | 0.00000 | 47 |
| 14 | 58 8 | 1 52 | 60985 | 2997 | 39015 | 60986 | 2996 | 39014 | 0.00000 | 0.00000 | 46 |
| 15 | 11 58 0 | 0 2 0 | 7.63982 | 2802 | 12.36018 | 7.63982 | 2803 | 12.36018 | 10.00000 | 10.00000 | 45 |
| 16 | 57 52 | 2 8 | 66784 | 2633 | 33216 | 66785 | 2633 | 33215 | 0.00000 | 0.00000 | 44 |
| 17 | 57 44 | 2 16 | 69417 | 2483 | 30583 | 69418 | 2482 | 30582 | 0.00001 | 9.99999 | 43 |
| 18 | 57 36 | 2 24 | 71900 | 2348 | 28100 | 71900 | 2348 | 28100 | 0.00001 | 9.99999 | 42 |
| 19 | 57 28 | 2 32 | 74248 | 2227 | 25752 | 74248 | 2228 | 25752 | 0.00001 | 9.99999 | 41 |
| 20 | 11 57 20 | 0 2 40 | 7.76475 | 2119 | 12.23524 | 7.76476 | 2119 | 12.23524 | 10.00001 | 9.99999 | 40 |
| 21 | 57 12 | 2 48 | 78594 | 2021 | 21406 | 78595 | 2020 | 21405 | 0.00001 | 9.99999 | 39 |
| 22 | 57 4 | 2 56 | 80615 | 1930 | 19385 | 80615 | 1931 | 19385 | 0.00001 | 9.99999 | 38 |
| 23 | 56 56 | 3 4 | 82545 | 1848 | 17455 | 82546 | 1848 | 17454 | 0.00001 | 9.99999 | 37 |
| 24 | 56 48 | 3 12 | 84393 | 1773 | 15607 | 84394 | 1773 | 15606 | 0.00001 | 9.99999 | 36 |
| 25 | 11 56 40 | 0 3 20 | 7.86166 | 1704 | 12.13833 | 7.86167 | 1704 | 12.13833 | 10.00001 | 9.99999 | 35 |
| 26 | 56 32 | 3 28 | 87870 | 1639 | 12130 | 87871 | 1639 | 12129 | 0.00001 | 9.99999 | 34 |
| 27 | 56 24 | 3 36 | 89509 | 1579 | 10491 | 89510 | 1579 | 10490 | 0.00001 | 9.99999 | 33 |
| 28 | 56 16 | 3 44 | 91088 | 1524 | 08912 | 91089 | 1524 | 08911 | 0.00001 | 9.99999 | 32 |

SINES, TANGENTS, AND SECANTS.

| | | | | | | | | | | | 178° |
|----|------------|------------|---------|-----------|-----------|------------|-----------|------------|-----------|---------|------|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. 1'. | Cosecant. | Tangent. | Diff. 1'. | Cotangent. | Secant. | Cosine. | M. |
| 0 | 11 52 0 | 0 8 0 | 8.24186 | 717 | 11.75814 | 8.24192 | 718 | 11.75808 | 10.00007 | 9.99993 | 60 |
| 1 | 51 52 | 8 8 | 24903 | 706 | 75097 | 24910 | 706 | 75090 | 00007 | 99993 | 59 |
| 2 | 51 44 | 8 16 | 25609 | 695 | 74391 | 25616 | 696 | 74384 | 00007 | 99993 | 58 |
| 3 | 51 36 | 8 24 | 26304 | 684 | 73696 | 26312 | 684 | 73688 | 00007 | 99993 | 57 |
| 4 | 51 28 | 8 32 | 26988 | 673 | 73012 | 26996 | 673 | 73004 | 00008 | 99992 | 56 |
| 5 | 11 51 20 | 0 8 40 | 8.27661 | 663 | 11.72339 | 8.27669 | 663 | 11.72331 | 10.00008 | 9.99992 | 55 |
| 6 | 51 12 | 8 48 | 28324 | 653 | 71676 | 28332 | 654 | 71668 | 00008 | 99992 | 54 |
| 7 | 51 4 | 8 56 | 28977 | 644 | 71023 | 28986 | 643 | 71014 | 00008 | 99992 | 53 |
| 8 | 50 56 | 9 4 | 29621 | 634 | 70379 | 29629 | 634 | 70371 | 00008 | 99992 | 52 |
| 9 | 50 48 | 9 12 | 30255 | 624 | 69745 | 30263 | 625 | 69737 | 00009 | 99991 | 51 |
| 10 | 11 50 40 | 0 9 20 | 8.30879 | 616 | 11.69121 | 8.30888 | 617 | 11.69112 | 10.00009 | 9.99991 | 50 |
| 11 | 50 32 | 9 28 | 31495 | 608 | 68505 | 31505 | 607 | 68495 | 00009 | 99991 | 49 |
| 12 | 50 24 | 9 36 | 32103 | 599 | 67897 | 32112 | 599 | 67888 | 00010 | 99990 | 48 |
| 13 | 50 16 | 9 44 | 32702 | 590 | 67298 | 32711 | 591 | 67289 | 00010 | 99990 | 47 |
| 14 | 50 8 | 9 52 | 33292 | 583 | 66708 | 33302 | 584 | 66698 | 00010 | 99990 | 46 |
| 15 | 11 50 0 | 0 10 0 | 8.33875 | 575 | 11.66125 | 8.33886 | 575 | 11.66114 | 10.00010 | 99990 | 45 |
| 16 | 49 52 | 10 8 | 34450 | 568 | 65550 | 34461 | 568 | 65539 | 00011 | 99989 | 44 |
| 17 | 49 44 | 10 16 | 35018 | 560 | 64982 | 35029 | 561 | 64971 | 00011 | 99989 | 43 |
| 18 | 49 36 | 10 24 | 35578 | 553 | 64422 | 35590 | 553 | 64410 | 00011 | 99989 | 42 |
| 19 | 49 28 | 10 32 | 36131 | 547 | 63869 | 36143 | 549 | 63857 | 00011 | 99989 | 41 |
| 20 | 11 49 20 | 0 10 40 | 8.36678 | 539 | 11.63322 | 8.36689 | 540 | 11.63311 | 10.00012 | 9.99988 | 40 |
| 21 | 49 12 | 10 48 | 37217 | 533 | 62783 | 37229 | 533 | 62771 | 00012 | 99988 | 39 |
| 22 | 49 4 | 10 56 | 37750 | 526 | 62250 | 37762 | 537 | 62238 | 00012 | 99988 | 38 |
| 23 | 48 56 | 11 4 | 38276 | 520 | 61724 | 38289 | 520 | 61711 | 00013 | 99987 | 37 |
| 24 | 48 48 | 11 12 | 38796 | 514 | 61204 | 38809 | 514 | 61191 | 00013 | 99987 | 36 |
| 25 | 11 48 40 | 0 11 20 | 8.39310 | 508 | 11.60690 | 8.39323 | 509 | 11.60677 | 10.00013 | 9.99987 | 35 |
| 26 | 48 32 | 11 28 | 39818 | 502 | 60182 | 39832 | 502 | 60168 | 00014 | 99986 | 34 |
| 27 | 48 24 | 11 36 | 40320 | 196 | 59680 | 40334 | 496 | 59666 | 00014 | 99986 | 33 |
| 28 | 48 16 | 11 44 | 40816 | 191 | 59184 | 40830 | 491 | 59170 | 00014 | 99986 | 32 |
| 29 | 48 8 | 11 52 | 41307 | 485 | 58693 | 41321 | 486 | 58679 | 00015 | 99985 | 31 |
| 30 | 11 48 0 | 0 12 0 | 8.41792 | 480 | 11.58208 | 8.41807 | 480 | 11.58193 | 10.00015 | 9.99985 | 30 |
| 31 | 47 52 | 12 8 | 42272 | 474 | 57728 | 42287 | 475 | 57713 | 00015 | 99985 | 29 |
| 32 | 47 44 | 12 16 | 42746 | 470 | 57254 | 42762 | 470 | 57238 | 00016 | 99984 | 28 |
| 33 | 47 36 | 12 24 | 43216 | 464 | 56784 | 43232 | 464 | 56768 | 00016 | 99984 | 27 |
| 34 | 47 28 | 12 32 | 43680 | 459 | 56320 | 43696 | 460 | 56304 | 00016 | 99984 | 26 |
| 35 | 11 47 20 | 0 12 40 | 8.44139 | 455 | 11.55861 | 8.44156 | 455 | 11.55844 | 10.00017 | 9.99983 | 25 |
| 36 | 47 12 | 12 48 | 44594 | 450 | 55406 | 44611 | 450 | 55389 | 00017 | 99983 | 24 |
| 37 | 47 4 | 12 56 | 45044 | 445 | 54956 | 45061 | 446 | 54939 | 00017 | 99983 | 23 |
| 38 | 46 56 | 13 4 | 45489 | 441 | 54511 | 45507 | 441 | 54493 | 00018 | 99982 | 22 |
| 39 | 46 48 | 13 12 | 45930 | 436 | 54070 | 45948 | 437 | 54052 | 00018 | 99982 | 21 |
| 40 | 11 46 40 | 0 13 20 | 8.46366 | 433 | 11.53634 | 8.46385 | 432 | 11.53615 | 10.00018 | 9.99982 | 20 |
| 41 | 46 32 | 13 28 | 46799 | 427 | 53201 | 46817 | 428 | 53183 | 00019 | 99981 | 19 |
| 42 | 46 24 | 13 36 | 47226 | 424 | 52774 | 47245 | 424 | 52755 | 00019 | 99981 | 18 |
| 43 | 46 16 | 13 44 | 47650 | 419 | 52350 | 47669 | 420 | 52331 | 00019 | 99981 | 17 |
| 44 | 46 8 | 13 52 | 48069 | 416 | 51931 | 48089 | 416 | 51911 | 00020 | 99980 | 16 |
| 45 | 11 46 0 | 0 14 0 | 8.48485 | 411 | 11.51515 | 8.48505 | 412 | 11.51495 | 10.00020 | 9.99980 | 15 |
| 46 | 45 52 | 14 8 | 48896 | 408 | 51104 | 48917 | 408 | 51083 | 00021 | 99979 | 14 |
| 47 | 45 44 | 14 16 | 49304 | 404 | 50696 | 49325 | 404 | 50675 | 00021 | 99979 | 13 |
| 48 | 45 36 | 14 24 | 49708 | 400 | 50292 | 49729 | 401 | 50271 | 00021 | 99979 | 12 |
| 49 | 45 28 | 14 32 | 50108 | 396 | 49892 | 50130 | 397 | 49870 | 00022 | 99978 | 11 |
| 50 | 11 45 20 | 0 14 40 | 8.50504 | 393 | 11.49496 | 8.50527 | 393 | 11.49473 | 10.00022 | 9.99978 | 10 |
| 51 | 45 12 | 14 48 | 50897 | 390 | 49103 | 50920 | 390 | 49080 | 00023 | 99977 | 9 |
| 52 | 45 4 | 14 56 | 51287 | 386 | 48713 | 51310 | 386 | 48690 | 00023 | 99977 | 8 |
| 53 | 44 56 | 15 4 | 51673 | 382 | 48327 | 51696 | 383 | 48304 | 00023 | 99977 | 7 |
| 54 | 44 48 | 15 12 | 52055 | 370 | 47945 | 52079 | 380 | 47921 | 00024 | 99976 | 6 |
| 55 | 11 44 40 | 0 15 20 | 8.52434 | 376 | 11.47566 | 8.52459 | 376 | 11.47541 | 10.00024 | 9.99976 | 5 |
| 56 | 44 32 | 15 28 | 52810 | 373 | 47190 | 52835 | 373 | 47165 | 00025 | 99975 | 4 |
| 57 | 44 24 | 15 36 | 53183 | 369 | 46817 | 53208 | 370 | 46792 | 00025 | 99975 | 3 |
| 58 | 44 16 | 15 44 | 53552 | 367 | 46448 | 53578 | 367 | 46422 | 00026 | 99974 | 2 |
| 59 | 44 8 | 15 52 | 53919 | 363 | 46081 | 53945 | 363 | 46055 | 00026 | 99974 | 1 |
| 60 | 44 0 | 16 0 | 54282 | 360 | 45718 | 54308 | 361 | 45692 | 00026 | 99974 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. 1'. | Secant. | Cotangent. | Diff. 1'. | Tangent. | Cosecant. | Sine. | M. |

SINES, TANGENTS, AND SECANTS.

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| N. | Hour A. M. | Hour P. M. | Sine. | Diff. s'. | Cosecant. | Tangent. | Diff. s'. | Cotangent. | Secant. | Cosine. | M. |
|----|------------|------------|---------|-----------|-----------|----------|-----------|------------|----------|---------|----|
| 0 | 11 44 0 | 0 16 0 | 8.54282 | 360 | 11.45718 | 8.54308 | 361 | 11.45692 | 10.00026 | 9.99974 | 60 |
| 1 | 43 52 | 16 8 | 54642 | 357 | 45358 | 54669 | 358 | 45331 | 00027 | 99973 | 59 |
| 2 | 43 44 | 16 16 | 54999 | 355 | 45001 | 55027 | 355 | 44973 | 00027 | 99973 | 58 |
| 3 | 43 36 | 16 24 | 55354 | 351 | 44646 | 55382 | 352 | 44618 | 00028 | 99972 | 57 |
| 4 | 43 28 | 16 32 | 55705 | 349 | 44295 | 55734 | 349 | 44266 | 00028 | 99972 | 56 |
| 5 | 11 43 20 | 0 16 40 | 8.56054 | 346 | 11.43946 | 8.56083 | 346 | 11.43917 | 10.00039 | 9.99971 | 55 |
| 6 | 43 12 | 16 48 | 56400 | 343 | 43600 | 56429 | 344 | 43571 | 00039 | 99971 | 54 |
| 7 | 43 4 | 16 56 | 56743 | 341 | 43257 | 56773 | 341 | 43227 | 00030 | 99970 | 53 |
| 8 | 42 56 | 17 4 | 57084 | 337 | 42916 | 57114 | 338 | 42886 | 00030 | 99970 | 52 |
| 9 | 42 48 | 17 12 | 57421 | 336 | 42579 | 57452 | 336 | 42548 | 00031 | 99969 | 51 |
| 10 | 11 42 40 | 0 17 20 | 8.57757 | 332 | 11.42243 | 8.57788 | 333 | 11.42212 | 10.00031 | 9.99969 | 50 |
| 11 | 42 32 | 17 28 | 58089 | 330 | 41911 | 58121 | 330 | 41879 | 00032 | 99968 | 49 |
| 12 | 42 24 | 17 36 | 58419 | 328 | 41581 | 58451 | 328 | 41549 | 00032 | 99968 | 48 |
| 13 | 42 16 | 17 44 | 58747 | 325 | 41253 | 58779 | 326 | 41221 | 00033 | 99967 | 47 |
| 14 | 42 8 | 17 52 | 59072 | 323 | 40928 | 59105 | 323 | 40895 | 00033 | 99967 | 46 |
| 15 | 11 42 0 | 0 18 0 | 8.59395 | 320 | 11.40605 | 8.59428 | 321 | 11.40572 | 10.00033 | 9.99967 | 45 |
| 16 | 41 52 | 18 8 | 59715 | 318 | 40285 | 59749 | 319 | 40251 | 00034 | 99966 | 44 |
| 17 | 41 44 | 18 16 | 60033 | 316 | 39967 | 60068 | 316 | 39932 | 00034 | 99966 | 43 |
| 18 | 41 36 | 18 24 | 60349 | 313 | 39651 | 60384 | 314 | 39616 | 00035 | 99965 | 42 |
| 19 | 41 28 | 18 32 | 60662 | 311 | 39338 | 60698 | 311 | 39302 | 00036 | 99964 | 41 |
| 20 | 11 41 20 | 0 18 40 | 8.60973 | 309 | 11.39027 | 8.61009 | 310 | 11.38991 | 10.00036 | 9.99964 | 40 |
| 21 | 41 12 | 18 48 | 61282 | 307 | 38718 | 61319 | 307 | 38681 | 00037 | 99963 | 39 |
| 22 | 41 4 | 18 56 | 61589 | 305 | 38411 | 61626 | 305 | 38374 | 00037 | 99963 | 38 |
| 23 | 40 56 | 19 4 | 61894 | 302 | 38106 | 61931 | 303 | 38069 | 00038 | 99962 | 37 |
| 24 | 40 48 | 19 12 | 62196 | 301 | 37804 | 62234 | 301 | 37766 | 00038 | 99962 | 36 |
| 25 | 11 40 40 | 0 19 20 | 8.62497 | 298 | 11.37503 | 8.62535 | 299 | 11.37465 | 10.00039 | 9.99961 | 35 |
| 26 | 40 32 | 19 28 | 62795 | 296 | 37205 | 62834 | 297 | 37166 | 00039 | 99961 | 34 |
| 27 | 40 24 | 19 36 | 63091 | 294 | 36909 | 63131 | 295 | 36869 | 00040 | 99960 | 33 |
| 28 | 40 16 | 19 44 | 63385 | 293 | 36615 | 63426 | 292 | 36574 | 00040 | 99960 | 32 |
| 29 | 40 8 | 19 52 | 63678 | 290 | 36322 | 63718 | 291 | 36282 | 00041 | 99959 | 31 |
| 30 | 11 40 0 | 0 20 0 | 8.63968 | 288 | 11.36032 | 8.64009 | 289 | 11.35991 | 10.00041 | 9.99959 | 30 |
| 31 | 39 52 | 20 8 | 64256 | 287 | 35744 | 64298 | 287 | 35702 | 00042 | 99958 | 29 |
| 32 | 39 44 | 20 16 | 64543 | 284 | 35457 | 64585 | 285 | 35415 | 00042 | 99958 | 28 |
| 33 | 39 36 | 20 24 | 64827 | 283 | 35173 | 64870 | 284 | 35130 | 00043 | 99957 | 27 |
| 34 | 39 28 | 20 32 | 65110 | 281 | 34890 | 65154 | 281 | 34846 | 00044 | 99956 | 26 |
| 35 | 11 39 20 | 0 20 40 | 8.65391 | 279 | 11.34609 | 8.65435 | 280 | 11.34565 | 10.00044 | 9.99956 | 25 |
| 36 | 39 12 | 20 48 | 65670 | 277 | 34330 | 65715 | 278 | 34285 | 00045 | 99955 | 24 |
| 37 | 39 4 | 20 56 | 65947 | 276 | 34053 | 65993 | 276 | 34007 | 00045 | 99955 | 23 |
| 38 | 38 56 | 21 4 | 66223 | 274 | 33777 | 66269 | 274 | 33731 | 00046 | 99954 | 22 |
| 39 | 38 48 | 21 12 | 66497 | 272 | 33503 | 66543 | 273 | 33457 | 00046 | 99954 | 21 |
| 40 | 11 38 40 | 0 21 20 | 8.66769 | 270 | 11.33231 | 8.66816 | 271 | 11.33184 | 10.00047 | 9.99953 | 20 |
| 41 | 38 32 | 21 28 | 67039 | 269 | 32961 | 67087 | 269 | 32913 | 00048 | 99952 | 19 |
| 42 | 38 24 | 21 36 | 67308 | 267 | 32692 | 67356 | 268 | 32644 | 00048 | 99952 | 18 |
| 43 | 38 16 | 21 44 | 67575 | 266 | 32425 | 67624 | 266 | 32376 | 00049 | 99951 | 17 |
| 44 | 38 8 | 21 52 | 67841 | 263 | 32159 | 67890 | 264 | 32110 | 00049 | 99951 | 16 |
| 45 | 11 38 0 | 0 22 0 | 8.68104 | 263 | 11.31896 | 8.68154 | 263 | 11.31846 | 10.00050 | 9.99950 | 15 |
| 46 | 37 52 | 22 8 | 68367 | 260 | 31633 | 68417 | 261 | 31583 | 00051 | 99949 | 14 |
| 47 | 37 44 | 22 16 | 68627 | 259 | 31373 | 68678 | 260 | 31322 | 00051 | 99949 | 13 |
| 48 | 37 36 | 22 24 | 68886 | 258 | 31114 | 68938 | 258 | 31062 | 00052 | 99948 | 12 |
| 49 | 37 28 | 22 32 | 69144 | 256 | 30856 | 69196 | 257 | 30804 | 00052 | 99948 | 11 |
| 50 | 11 37 20 | 0 22 40 | 8.69400 | 254 | 11.30600 | 8.69453 | 255 | 11.30547 | 10.00053 | 9.99947 | 10 |
| 51 | 37 12 | 22 48 | 69654 | 253 | 30346 | 69708 | 254 | 30292 | 00054 | 99946 | 9 |
| 52 | 37 4 | 22 56 | 69907 | 252 | 30093 | 69962 | 252 | 30038 | 00054 | 99946 | 8 |
| 53 | 36 56 | 23 4 | 70159 | 250 | 29841 | 70214 | 251 | 29786 | 00055 | 99945 | 7 |
| 54 | 36 48 | 23 12 | 70409 | 249 | 29591 | 70465 | 249 | 29535 | 00056 | 99944 | 6 |
| 55 | 11 36 40 | 0 23 20 | 8.70658 | 247 | 11.29342 | 8.70714 | 248 | 11.29286 | 10.00056 | 9.99944 | 5 |
| 56 | 36 32 | 23 28 | 70905 | 246 | 29095 | 70962 | 246 | 29038 | 00057 | 99943 | 4 |
| 57 | 36 24 | 23 36 | 71151 | 244 | 28849 | 71208 | 245 | 28792 | 00058 | 99942 | 3 |
| 58 | 36 16 | 23 44 | 71395 | 243 | 28605 | 71453 | 244 | 28547 | 00058 | 99942 | 2 |
| 59 | 36 8 | 23 52 | 71638 | 242 | 28362 | 71697 | 243 | 28303 | 00059 | 99941 | 1 |
| 60 | 36 0 | 24 0 | 71880 | 240 | 28120 | 71940 | 241 | 28060 | 00060 | 99940 | 0 |

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. s'. | Secant. | Cotangent. | Diff. s'. | Tangent. | Cosecant. | Sine. | M. |
|----|------------|------------|---------|-----------|---------|------------|-----------|----------|-----------|-------|----|
|----|------------|------------|---------|-----------|---------|------------|-----------|----------|-----------|-------|----|

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. 1'. | Cosecant. | Tangent. | Diff. 1'. | Cotangent. | Secant. | Cosine. | M. |
|----|------------|------------|----------|-----------|-----------|------------|-----------|------------|-----------|----------|----|
| 0 | 11 36 0 | 0 24 0 | 8. 71880 | 240 | 11. 28120 | 8. 71940 | 241 | 11. 28060 | 10. 00060 | 9. 99940 | 60 |
| 1 | 35 52 | 24 8 | 72120 | 239 | 27880 | 72181 | 239 | 27819 | 00060 | 99940 | 59 |
| 2 | 35 44 | 24 16 | 72359 | 238 | 27641 | 72420 | 239 | 27580 | 00061 | 99939 | 58 |
| 3 | 35 36 | 24 24 | 72597 | 237 | 27403 | 72659 | 237 | 27341 | 00062 | 99938 | 57 |
| 4 | 35 28 | 24 31 | 72834 | 235 | 27166 | 72896 | 236 | 27104 | 00062 | 99938 | 56 |
| 5 | 11 35 20 | 0 24 41 | 8. 73069 | 234 | 11. 26931 | 8. 73132 | 234 | 11. 26868 | 10. 00063 | 9. 99937 | 55 |
| 6 | 35 12 | 24 48 | 73303 | 232 | 26697 | 73366 | 234 | 26634 | 00064 | 99936 | 54 |
| 7 | 35 4 | 24 56 | 73535 | 232 | 26465 | 73600 | 232 | 26400 | 00064 | 99936 | 53 |
| 8 | 34 56 | 25 4 | 73767 | 230 | 26233 | 73832 | 231 | 26168 | 00065 | 99935 | 52 |
| 9 | 34 48 | 25 12 | 73997 | 229 | 26003 | 74063 | 229 | 25937 | 00066 | 99934 | 51 |
| 10 | 11 34 40 | 0 25 20 | 8. 74226 | 228 | 11. 25774 | 8. 74292 | 229 | 11. 25708 | 10. 00066 | 9. 99934 | 50 |
| 11 | 34 32 | 25 28 | 74454 | 226 | 25546 | 74521 | 227 | 25479 | 00067 | 99933 | 49 |
| 12 | 34 24 | 25 36 | 74680 | 226 | 25320 | 74748 | 226 | 25252 | 00068 | 99932 | 48 |
| 13 | 34 16 | 25 44 | 74906 | 224 | 25094 | 74974 | 225 | 25026 | 00068 | 99932 | 47 |
| 14 | 34 8 | 25 52 | 75130 | 223 | 24870 | 75199 | 224 | 24801 | 00069 | 99931 | 46 |
| 15 | 11 34 0 | 0 26 0 | 8. 75353 | 222 | 11. 24647 | 8. 75423 | 222 | 11. 24577 | 10. 00070 | 9. 99930 | 45 |
| 16 | 33 52 | 26 8 | 75575 | 220 | 24425 | 75645 | 222 | 24355 | 00071 | 99929 | 44 |
| 17 | 33 44 | 26 16 | 75795 | 220 | 24205 | 75867 | 220 | 24133 | 00071 | 99929 | 43 |
| 18 | 33 36 | 26 24 | 76015 | 219 | 23985 | 76087 | 219 | 23913 | 00072 | 99928 | 42 |
| 19 | 33 28 | 26 32 | 76234 | 217 | 23766 | 76306 | 219 | 23694 | 00073 | 99927 | 41 |
| 20 | 11 33 20 | 0 26 40 | 8. 76451 | 216 | 11. 23549 | 8. 76525 | 217 | 11. 23475 | 10. 00074 | 9. 99926 | 40 |
| 21 | 33 12 | 26 48 | 76667 | 216 | 23333 | 76742 | 216 | 23258 | 00074 | 99926 | 39 |
| 22 | 33 4 | 26 56 | 76883 | 214 | 23117 | 76958 | 215 | 23042 | 00075 | 99925 | 38 |
| 23 | 32 56 | 27 4 | 77097 | 213 | 22903 | 77173 | 214 | 22827 | 00076 | 99924 | 37 |
| 24 | 32 48 | 27 12 | 77310 | 212 | 22690 | 77387 | 213 | 22613 | 00077 | 99923 | 36 |
| 25 | 11 32 40 | 0 27 20 | 8. 77522 | 211 | 11. 22478 | 8. 77600 | 211 | 11. 22400 | 10. 00077 | 9. 99923 | 35 |
| 26 | 32 32 | 27 28 | 77733 | 210 | 22267 | 77811 | 211 | 22189 | 00078 | 99922 | 34 |
| 27 | 32 24 | 27 36 | 77943 | 209 | 22057 | 78022 | 210 | 21978 | 00079 | 99921 | 33 |
| 28 | 32 16 | 27 44 | 78152 | 208 | 21848 | 78232 | 209 | 21768 | 00080 | 99920 | 32 |
| 29 | 32 8 | 27 52 | 78360 | 208 | 21640 | 78441 | 208 | 21559 | 00080 | 99920 | 31 |
| 30 | 11 32 0 | 0 28 0 | 8. 78568 | 206 | 11. 21432 | 8. 78649 | 206 | 11. 21351 | 10. 00081 | 9. 99919 | 30 |
| 31 | 31 52 | 28 8 | 78774 | 205 | 21226 | 78855 | 206 | 21145 | 00082 | 99918 | 29 |
| 32 | 31 44 | 28 16 | 78979 | 204 | 21021 | 79061 | 205 | 20939 | 00083 | 99917 | 28 |
| 33 | 31 36 | 28 24 | 79183 | 203 | 20817 | 79266 | 204 | 20734 | 00083 | 99917 | 27 |
| 34 | 31 28 | 28 32 | 79386 | 202 | 20614 | 79470 | 203 | 20530 | 00084 | 99916 | 26 |
| 35 | 11 31 20 | 0 28 40 | 8. 79588 | 201 | 11. 20412 | 8. 79673 | 202 | 11. 20327 | 10. 00085 | 9. 99915 | 25 |
| 36 | 31 12 | 28 48 | 79789 | 201 | 20211 | 79875 | 201 | 20125 | 00086 | 99914 | 24 |
| 37 | 31 4 | 28 56 | 79990 | 199 | 20010 | 80076 | 201 | 19924 | 00087 | 99913 | 23 |
| 38 | 30 56 | 29 4 | 80189 | 199 | 19811 | 80277 | 199 | 19723 | 00087 | 99913 | 22 |
| 39 | 30 48 | 29 12 | 80388 | 197 | 19612 | 80476 | 198 | 19524 | 00088 | 99912 | 21 |
| 40 | 11 30 40 | 0 29 20 | 8. 80585 | 197 | 11. 19415 | 8. 80674 | 198 | 11. 19326 | 10. 00089 | 9. 99911 | 20 |
| 41 | 30 32 | 29 28 | 80782 | 196 | 19218 | 80872 | 196 | 19128 | 00090 | 99910 | 19 |
| 42 | 30 24 | 29 36 | 80978 | 195 | 19022 | 81068 | 196 | 18932 | 00091 | 99909 | 18 |
| 43 | 30 16 | 29 44 | 81173 | 194 | 18827 | 81264 | 195 | 18736 | 00091 | 99909 | 17 |
| 44 | 30 8 | 29 52 | 81367 | 193 | 18633 | 81459 | 194 | 18541 | 00092 | 99908 | 16 |
| 45 | 11 30 0 | 0 30 0 | 8. 81560 | 192 | 11. 18440 | 8. 81653 | 193 | 11. 18347 | 10. 00093 | 9. 99907 | 15 |
| 46 | 29 52 | 30 8 | 81752 | 192 | 18248 | 81846 | 192 | 18154 | 00094 | 99906 | 14 |
| 47 | 29 44 | 30 16 | 81944 | 190 | 18056 | 82038 | 192 | 17962 | 00095 | 99905 | 13 |
| 48 | 29 36 | 30 24 | 82134 | 190 | 17866 | 82230 | 190 | 17770 | 00096 | 99904 | 12 |
| 49 | 29 28 | 30 32 | 82324 | 189 | 17676 | 82420 | 190 | 17580 | 00096 | 99904 | 11 |
| 50 | 11 29 20 | 0 30 40 | 8. 82513 | 188 | 11. 17487 | 8. 82610 | 189 | 11. 17390 | 10. 00097 | 9. 99903 | 10 |
| 51 | 29 12 | 30 48 | 82701 | 187 | 17299 | 82799 | 188 | 17201 | 00098 | 99902 | 9 |
| 52 | 29 4 | 30 56 | 82888 | 187 | 17112 | 82987 | 188 | 17013 | 00099 | 99901 | 8 |
| 53 | 28 56 | 31 4 | 83075 | 186 | 16925 | 83175 | 186 | 16825 | 00100 | 99900 | 7 |
| 54 | 28 48 | 31 12 | 83261 | 185 | 16739 | 83361 | 186 | 16639 | 00101 | 99899 | 6 |
| 55 | 11 28 40 | 0 31 20 | 8. 83446 | 184 | 11. 16554 | 8. 83547 | 185 | 11. 16453 | 10. 00102 | 9. 99898 | 5 |
| 56 | 28 32 | 31 28 | 83630 | 183 | 16370 | 83732 | 184 | 16268 | 00102 | 99898 | 4 |
| 57 | 28 24 | 31 36 | 83813 | 183 | 16187 | 83916 | 184 | 16084 | 00103 | 99897 | 3 |
| 58 | 28 16 | 31 44 | 83996 | 181 | 16004 | 84100 | 182 | 15900 | 00104 | 99896 | 2 |
| 59 | 28 8 | 31 52 | 84177 | 181 | 15823 | 84282 | 182 | 15718 | 00105 | 99895 | 1 |
| 60 | 28 0 | 32 0 | 84358 | 181 | 15642 | 84464 | 182 | 15536 | 00106 | 99894 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. 1'. | Secant. | Cotangent. | Diff. 1'. | Tangent. | Cosecant. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. r'. | Cosecant. | Tangent. | Diff. r'. | Cotangent. | Secant. | Cosine. | M. |
|----|------------|------------|---------|-----------|-----------|----------|-----------|------------|----------|---------|----|
| 0 | 11-28 0 | 0 32 0 | 8.84358 | 181 | 11.15642 | 8.84464 | 182 | 11.15536 | 10.00106 | 9.99894 | 60 |
| 1 | 27 52 | 32 8 | 84539 | 179 | 15461 | 84646 | 180 | 15354 | 00107 | 99893 | 59 |
| 2 | 27 44 | 32 16 | 84718 | 179 | 15282 | 84826 | 180 | 15174 | 00108 | 99892 | 58 |
| 3 | 27 36 | 32 24 | 84897 | 178 | 15103 | 85006 | 179 | 14994 | 00109 | 99891 | 57 |
| 4 | 27 28 | 32 32 | 85075 | 177 | 14925 | 85185 | 178 | 14815 | 00109 | 99891 | 56 |
| 5 | 27 20 | 0 32 40 | 8.85252 | 177 | 11.14748 | 8.85363 | 177 | 11.14637 | 10.00110 | 9.99890 | 55 |
| 6 | 27 12 | 32 48 | 85429 | 176 | 14571 | 85540 | 177 | 14460 | 00111 | 99889 | 54 |
| 7 | 27 4 | 32 56 | 85605 | 175 | 14395 | 85717 | 176 | 14283 | 00112 | 99888 | 53 |
| 8 | 26 56 | 33 4 | 85780 | 175 | 14220 | 85893 | 176 | 14107 | 00113 | 99887 | 52 |
| 9 | 26 48 | 33 12 | 85955 | 173 | 14045 | 86069 | 174 | 13931 | 00114 | 99886 | 51 |
| 10 | 26 40 | 0 33 20 | 8.86128 | 173 | 11.13872 | 8.86243 | 174 | 11.13757 | 10.00115 | 9.99885 | 50 |
| 11 | 26 32 | 33 28 | 86301 | 173 | 13699 | 86417 | 174 | 13583 | 00116 | 99884 | 49 |
| 12 | 26 24 | 33 36 | 86474 | 171 | 13526 | 86591 | 172 | 13409 | 00117 | 99883 | 48 |
| 13 | 26 16 | 33 44 | 86645 | 171 | 13355 | 86763 | 172 | 13237 | 00118 | 99882 | 47 |
| 14 | 26 8 | 33 52 | 86816 | 171 | 13184 | 86935 | 171 | 13065 | 00119 | 99881 | 46 |
| 15 | 25 52 | 0 34 0 | 8.86987 | 169 | 11.13013 | 8.87106 | 171 | 11.12894 | 10.00120 | 9.99880 | 45 |
| 16 | 25 44 | 34 8 | 87156 | 169 | 12844 | 87277 | 170 | 12723 | 00121 | 99879 | 44 |
| 17 | 25 36 | 34 16 | 87325 | 169 | 12675 | 87447 | 169 | 12553 | 00121 | 99879 | 43 |
| 18 | 25 28 | 34 24 | 87494 | 167 | 12506 | 87616 | 169 | 12384 | 00122 | 99878 | 42 |
| 19 | 25 20 | 34 32 | 87661 | 168 | 12339 | 87785 | 168 | 12215 | 00123 | 99877 | 41 |
| 20 | 25 12 | 0 34 40 | 8.87829 | 166 | 11.12171 | 8.87953 | 167 | 11.12047 | 10.00124 | 9.99876 | 40 |
| 21 | 25 4 | 34 48 | 87995 | 166 | 12005 | 88120 | 167 | 11880 | 00125 | 99875 | 39 |
| 22 | 24 56 | 34 56 | 88161 | 165 | 11839 | 88287 | 166 | 11713 | 00126 | 99874 | 38 |
| 23 | 24 48 | 35 4 | 88326 | 164 | 11674 | 88453 | 165 | 11547 | 00127 | 99873 | 37 |
| 24 | 24 40 | 35 12 | 88490 | 164 | 11510 | 88618 | 165 | 11382 | 00128 | 99872 | 36 |
| 25 | 24 32 | 0 35 20 | 8.88654 | 163 | 11.11346 | 8.88783 | 165 | 11.11217 | 10.00129 | 9.99871 | 35 |
| 26 | 24 24 | 35 28 | 88817 | 163 | 11183 | 88948 | 163 | 11052 | 00130 | 99870 | 34 |
| 27 | 24 16 | 35 36 | 88980 | 162 | 11020 | 89111 | 163 | 10889 | 00131 | 99869 | 33 |
| 28 | 24 8 | 35 44 | 89142 | 162 | 10858 | 89274 | 163 | 10726 | 00132 | 99868 | 32 |
| 29 | 24 0 | 35 52 | 89304 | 160 | 10696 | 89437 | 161 | 10563 | 00133 | 99867 | 31 |
| 30 | 23 52 | 0 36 0 | 8.89464 | 161 | 11.10536 | 8.89598 | 162 | 11.10402 | 10.00134 | 9.99866 | 30 |
| 31 | 23 44 | 36 8 | 89625 | 159 | 10375 | 89760 | 160 | 10240 | 00135 | 99865 | 29 |
| 32 | 23 36 | 36 16 | 89784 | 159 | 10216 | 89920 | 160 | 10080 | 00136 | 99864 | 28 |
| 33 | 23 28 | 36 24 | 89943 | 159 | 10057 | 90080 | 160 | 99920 | 00137 | 99863 | 27 |
| 34 | 23 20 | 36 32 | 90102 | 158 | 98988 | 90240 | 159 | 99760 | 00138 | 99862 | 26 |
| 35 | 23 12 | 0 36 40 | 8.90260 | 157 | 11.09740 | 8.90399 | 158 | 11.09601 | 10.00139 | 9.99861 | 25 |
| 36 | 23 4 | 36 48 | 90417 | 157 | 99583 | 90557 | 158 | 99443 | 00140 | 99860 | 24 |
| 37 | 22 56 | 36 56 | 90574 | 156 | 99426 | 90715 | 157 | 99285 | 00141 | 99859 | 23 |
| 38 | 22 48 | 37 4 | 90730 | 155 | 99270 | 90872 | 157 | 99128 | 00142 | 99858 | 22 |
| 39 | 22 40 | 37 12 | 90885 | 155 | 99115 | 91029 | 156 | 98971 | 00143 | 99857 | 21 |
| 40 | 22 32 | 0 37 20 | 8.91040 | 155 | 11.08960 | 8.91185 | 155 | 11.08815 | 10.00144 | 9.99856 | 20 |
| 41 | 22 24 | 37 28 | 91195 | 154 | 08805 | 91340 | 155 | 08660 | 00145 | 99855 | 19 |
| 42 | 22 16 | 37 36 | 91349 | 153 | 08651 | 91495 | 155 | 08505 | 00146 | 99854 | 18 |
| 43 | 22 8 | 37 44 | 91502 | 153 | 08498 | 91650 | 153 | 08350 | 00147 | 99853 | 17 |
| 44 | 22 0 | 37 52 | 91655 | 152 | 08345 | 91803 | 154 | 08197 | 00148 | 99852 | 16 |
| 45 | 21 52 | 0 38 0 | 8.91807 | 152 | 11.08193 | 8.91957 | 153 | 11.08043 | 10.00149 | 9.99851 | 15 |
| 46 | 21 44 | 38 8 | 91959 | 151 | 08041 | 92110 | 152 | 07890 | 00150 | 99850 | 14 |
| 47 | 21 36 | 38 16 | 92110 | 151 | 07890 | 92262 | 152 | 07738 | 00151 | 99849 | 13 |
| 48 | 21 28 | 38 24 | 92261 | 150 | 07739 | 92414 | 151 | 07586 | 00153 | 99847 | 12 |
| 49 | 21 20 | 38 32 | 92411 | 150 | 07586 | 92565 | 151 | 07435 | 00154 | 99846 | 11 |
| 50 | 21 12 | 0 38 40 | 8.92561 | 149 | 11.07439 | 8.92716 | 150 | 11.07284 | 10.00155 | 9.99845 | 10 |
| 51 | 21 4 | 38 48 | 92710 | 149 | 07290 | 92866 | 150 | 07134 | 00156 | 99844 | 9 |
| 52 | 20 56 | 38 56 | 92859 | 148 | 07141 | 93016 | 149 | 06984 | 00157 | 99843 | 8 |
| 53 | 20 48 | 39 4 | 93007 | 147 | 06993 | 93165 | 148 | 06835 | 00158 | 99842 | 7 |
| 54 | 20 40 | 39 12 | 93154 | 147 | 06846 | 93313 | 149 | 06687 | 00159 | 99841 | 6 |
| 55 | 20 32 | 0 39 20 | 8.93301 | 147 | 11.06699 | 8.93462 | 147 | 11.06538 | 10.00160 | 9.99840 | 5 |
| 56 | 20 24 | 39 28 | 93448 | 146 | 06652 | 93609 | 147 | 06491 | 00161 | 99839 | 4 |
| 57 | 20 16 | 39 36 | 93594 | 146 | 06506 | 93756 | 147 | 06344 | 00162 | 99838 | 3 |
| 58 | 20 8 | 39 44 | 93740 | 145 | 06260 | 93903 | 146 | 06197 | 00163 | 99837 | 2 |
| 59 | 20 0 | 39 52 | 93885 | 145 | 06115 | 94049 | 146 | 06051 | 00164 | 99836 | 1 |
| 60 | | 40 0 | 94030 | 144 | 05970 | 94195 | 145 | 05805 | 00166 | 99834 | 0 |

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. r'. | Secant. | Cotangent. | Diff. r'. | Tangent. | Cosecant. | Sine. | M. |
|----|------------|------------|---------|-----------|---------|------------|-----------|----------|-----------|-------|----|
|----|------------|------------|---------|-----------|---------|------------|-----------|----------|-----------|-------|----|

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 11 20 00 | 0 40 0 | 8.94030 | 0 | 11.05970 | 8.94195 | 0 | 11.05805 | 10.00166 | 0 | 9.99834 | 60 |
| 1 | 19 52 | 40 8 | 94174 | 2 | 05826 | 94340 | 2 | 05660 | 00167 | 0 | 99833 | 59 |
| 2 | 19 44 | 40 16 | 94317 | 4 | 05683 | 94485 | 4 | 05515 | 00168 | 0 | 99832 | 58 |
| 3 | 19 36 | 40 24 | 94461 | 7 | 05539 | 94630 | 7 | 05370 | 00169 | 0 | 99831 | 57 |
| 4 | 19 28 | 40 32 | 94603 | 9 | 05397 | 94773 | 9 | 05227 | 00170 | 0 | 99830 | 56 |
| 5 | 11 19 20 | 0 40 40 | 8.94746 | 11 | 11.05254 | 8.94917 | 11 | 11.05083 | 10.00171 | 0 | 9.99829 | 55 |
| 6 | 19 12 | 40 48 | 94887 | 13 | 05113 | 95060 | 13 | 04940 | 00172 | 0 | 99828 | 54 |
| 7 | 19 4 | 40 56 | 95029 | 15 | 04971 | 95202 | 15 | 04798 | 00173 | 0 | 99827 | 53 |
| 8 | 18 56 | 41 4 | 95170 | 18 | 04830 | 95344 | 18 | 04656 | 00175 | 0 | 99825 | 52 |
| 9 | 18 48 | 41 12 | 95310 | 20 | 04690 | 95486 | 20 | 04514 | 00176 | 0 | 99824 | 51 |
| 10 | 11 18 40 | 0 41 20 | 8.95450 | 22 | 11.04550 | 8.95627 | 22 | 11.04373 | 10.00177 | 0 | 9.99823 | 50 |
| 11 | 18 32 | 41 28 | 95589 | 24 | 04411 | 95767 | 24 | 04233 | 00178 | 0 | 99822 | 49 |
| 12 | 18 24 | 41 36 | 95728 | 26 | 04272 | 95908 | 27 | 04092 | 00179 | 0 | 99821 | 48 |
| 13 | 18 16 | 41 44 | 95867 | 29 | 04133 | 96047 | 29 | 03953 | 00180 | 0 | 99820 | 47 |
| 14 | 18 8 | 41 52 | 96005 | 31 | 03995 | 96187 | 31 | 03813 | 00181 | 0 | 99819 | 46 |
| 15 | 11 18 0 | 0 42 0 | 8.96143 | 33 | 11.03857 | 8.96325 | 33 | 11.03675 | 10.00183 | 0 | 9.99817 | 45 |
| 16 | 17 52 | 42 8 | 96280 | 35 | 03720 | 96464 | 35 | 03536 | 00184 | 0 | 99816 | 44 |
| 17 | 17 44 | 42 16 | 96417 | 37 | 03583 | 96602 | 38 | 03398 | 00185 | 0 | 99815 | 43 |
| 18 | 17 36 | 42 24 | 96553 | 39 | 03447 | 96739 | 40 | 03261 | 00186 | 0 | 99814 | 42 |
| 19 | 17 28 | 42 32 | 96689 | 42 | 03311 | 96877 | 42 | 03123 | 00187 | 0 | 99813 | 41 |
| 20 | 11 17 20 | 0 42 40 | 8.96825 | 44 | 11.03175 | 8.97013 | 44 | 11.02987 | 10.00188 | 0 | 9.99812 | 40 |
| 21 | 17 12 | 42 48 | 96960 | 46 | 03040 | 97150 | 46 | 02850 | 00190 | 0 | 99810 | 39 |
| 22 | 17 4 | 42 56 | 97095 | 48 | 02905 | 97285 | 49 | 02715 | 00191 | 0 | 99809 | 38 |
| 23 | 16 56 | 43 4 | 97229 | 50 | 02771 | 97421 | 51 | 02579 | 00192 | 0 | 99808 | 37 |
| 24 | 16 48 | 43 12 | 97363 | 53 | 02637 | 97556 | 53 | 02444 | 00193 | 0 | 99807 | 36 |
| 25 | 11 16 40 | 0 43 20 | 8.97496 | 55 | 11.02504 | 8.97691 | 55 | 11.02349 | 10.00194 | 1 | 9.99806 | 35 |
| 26 | 16 32 | 43 28 | 97629 | 57 | 02371 | 97825 | 58 | 02175 | 00196 | 1 | 99804 | 34 |
| 27 | 16 24 | 43 36 | 97762 | 59 | 02238 | 97959 | 60 | 02041 | 00197 | 1 | 99803 | 33 |
| 28 | 16 16 | 43 44 | 97894 | 61 | 02106 | 98092 | 62 | 01908 | 00198 | 1 | 99802 | 32 |
| 29 | 16 8 | 43 52 | 98026 | 64 | 01974 | 98225 | 64 | 01775 | 00199 | 1 | 99801 | 31 |
| 30 | 11 16 0 | 0 44 0 | 8.98157 | 66 | 11.01843 | 8.98358 | 66 | 11.01642 | 10.00200 | 1 | 9.99800 | 30 |
| 31 | 15 52 | 44 8 | 98288 | 68 | 01712 | 98490 | 69 | 01510 | 00202 | 1 | 99798 | 29 |
| 32 | 15 44 | 44 16 | 98419 | 70 | 01581 | 98622 | 71 | 01378 | 00203 | 1 | 99797 | 28 |
| 33 | 15 36 | 44 24 | 98549 | 72 | 01451 | 98753 | 73 | 01247 | 00204 | 1 | 99796 | 27 |
| 34 | 15 28 | 44 32 | 98679 | 75 | 01321 | 98884 | 75 | 01116 | 00205 | 1 | 99795 | 26 |
| 35 | 11 15 20 | 0 44 40 | 8.98808 | 77 | 11.01192 | 8.99015 | 77 | 11.00985 | 10.00207 | 1 | 9.99793 | 25 |
| 36 | 15 12 | 44 48 | 98937 | 79 | 01063 | 99145 | 80 | 00855 | 00208 | 1 | 99792 | 24 |
| 37 | 15 4 | 44 56 | 99066 | 81 | 00934 | 99275 | 82 | 00725 | 00209 | 1 | 99791 | 23 |
| 38 | 14 56 | 45 4 | 99194 | 83 | 00806 | 99405 | 84 | 00595 | 00210 | 1 | 99790 | 22 |
| 39 | 14 48 | 45 12 | 99322 | 86 | 00678 | 99534 | 86 | 00466 | 00212 | 1 | 99788 | 21 |
| 40 | 11 14 40 | 0 45 20 | 8.99450 | 88 | 11.00550 | 8.99662 | 89 | 11.00338 | 10.00213 | 1 | 9.99787 | 20 |
| 41 | 14 32 | 45 28 | 99577 | 90 | 00423 | 99791 | 91 | 00209 | 00214 | 1 | 99786 | 19 |
| 42 | 14 24 | 45 36 | 99704 | 92 | 00290 | 99919 | 93 | 00081 | 00215 | 1 | 99785 | 18 |
| 43 | 14 16 | 45 44 | 99830 | 94 | 00170 | 9.00046 | 95 | 10.99954 | 00217 | 1 | 99783 | 17 |
| 44 | 14 8 | 45 52 | 99956 | 96 | 00044 | 00174 | 97 | 99826 | 00218 | 1 | 99782 | 16 |
| 45 | 11 14 0 | 0 46 0 | 9.00082 | 99 | 10.99918 | 9.00301 | 100 | 10.99699 | 10.00219 | 1 | 9.99781 | 15 |
| 46 | 13 52 | 46 8 | 00207 | 101 | 99793 | 00427 | 102 | 99573 | 00220 | 1 | 99780 | 14 |
| 47 | 13 44 | 46 16 | 00332 | 103 | 99668 | 00553 | 104 | 99447 | 00222 | 1 | 99778 | 13 |
| 48 | 13 36 | 46 24 | 00456 | 105 | 99544 | 00679 | 106 | 99321 | 00223 | 1 | 99777 | 12 |
| 49 | 13 28 | 46 32 | 00581 | 107 | 99419 | 00805 | 108 | 99195 | 00224 | 1 | 99776 | 11 |
| 50 | 11 13 20 | 0 46 40 | 9.00704 | 110 | 10.99296 | 9.00930 | 111 | 10.99070 | 10.00225 | 1 | 9.99775 | 10 |
| 51 | 13 12 | 46 48 | 00828 | 112 | 99172 | 01055 | 113 | 98945 | 00227 | 1 | 99773 | 9 |
| 52 | 13 4 | 46 56 | 00951 | 114 | 99049 | 01179 | 115 | 98821 | 00228 | 1 | 99772 | 8 |
| 53 | 12 56 | 47 4 | 01074 | 116 | 98926 | 01303 | 117 | 98697 | 00229 | 1 | 99771 | 7 |
| 54 | 12 48 | 47 12 | 01196 | 118 | 98804 | 01427 | 120 | 98573 | 00231 | 1 | 99769 | 6 |
| 55 | 11 12 40 | 0 47 20 | 9.01318 | 121 | 10.98682 | 9.01550 | 122 | 10.98450 | 10.00232 | 1 | 9.99768 | 5 |
| 56 | 12 32 | 47 28 | 01440 | 123 | 98560 | 01673 | 124 | 98327 | 00233 | 1 | 99767 | 4 |
| 57 | 12 24 | 47 36 | 01561 | 125 | 98439 | 01796 | 126 | 98204 | 00235 | 1 | 99765 | 3 |
| 58 | 12 16 | 47 44 | 01682 | 127 | 98318 | 01918 | 128 | 98082 | 00236 | 1 | 99764 | 2 |
| 59 | 12 8 | 47 52 | 01803 | 129 | 98197 | 02040 | 131 | 97960 | 00237 | 1 | 99763 | 1 |
| 60 | 12 0 | 48 0 | 01923 | 132 | 98077 | 02162 | 133 | 97838 | 00239 | 1 | 99761 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sec. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 11 12 0 | 0 48 0 | 9.01923 | 0 | 10.98077 | 9.02162 | 0 | 10.97838 | 10.00239 | 0 | 9.99761 | 60 |
| 1 | 11 52 | 48 8 | 02043 | 2 | 97957 | 02283 | 2 | 97717 | 00240 | 0 | 99760 | 59 |
| 2 | 11 44 | 48 16 | 02163 | 4 | 97837 | 02404 | 4 | 97596 | 00241 | 0 | 99759 | 58 |
| 3 | 11 36 | 48 24 | 02283 | 6 | 97717 | 02525 | 6 | 97475 | 00243 | 0 | 99757 | 57 |
| 4 | 11 28 | 48 32 | 02402 | 7 | 97598 | 02645 | 8 | 97355 | 00244 | 0 | 99756 | 56 |
| 5 | 11 11 20 | 0 48 40 | 9.02520 | 9 | 10.97480 | 9.02766 | 9 | 12.97234 | 10.00245 | 0 | 9.99755 | 55 |
| 6 | 11 12 | 48 48 | 02639 | 11 | 97361 | 02885 | 11 | 97115 | 00247 | 0 | 99753 | 54 |
| 7 | 11 4 | 48 56 | 02757 | 13 | 97243 | 03005 | 13 | 96995 | 00248 | 0 | 99752 | 53 |
| 8 | 10 56 | 49 4 | 02874 | 15 | 97126 | 03124 | 15 | 96876 | 00249 | 0 | 99751 | 52 |
| 9 | 10 48 | 49 12 | 02992 | 17 | 97008 | 03242 | 17 | 96758 | 00251 | 0 | 99749 | 51 |
| 10 | 11 10 40 | 0 49 20 | 9.03109 | 19 | 10.96891 | 9.03361 | 19 | 10.96639 | 10.00252 | 0 | 9.99748 | 50 |
| 11 | 10 32 | 49 28 | 03226 | 20 | 96774 | 03479 | 21 | 96511 | 00253 | 0 | 99747 | 49 |
| 12 | 10 24 | 49 36 | 03342 | 22 | 96658 | 03597 | 23 | 96403 | 00255 | 0 | 99745 | 48 |
| 13 | 10 16 | 49 44 | 03458 | 24 | 96542 | 03714 | 24 | 96286 | 00256 | 0 | 99744 | 47 |
| 14 | 10 8 | 49 52 | 03574 | 26 | 96426 | 03832 | 26 | 96168 | 00258 | 0 | 99742 | 46 |
| 15 | 11 10 0 | 0 50 0 | 9.03690 | 28 | 10.96310 | 9.03948 | 28 | 10.96052 | 10.00259 | 0 | 9.99741 | 45 |
| 16 | 9 52 | 50 8 | 03805 | 30 | 96195 | 04065 | 30 | 95935 | 00260 | 0 | 99740 | 44 |
| 17 | 9 44 | 50 16 | 03920 | 31 | 96080 | 04181 | 32 | 95819 | 00262 | 0 | 99738 | 43 |
| 18 | 9 36 | 50 24 | 04034 | 33 | 95966 | 04297 | 34 | 95703 | 00263 | 0 | 99737 | 42 |
| 19 | 9 28 | 50 32 | 04149 | 35 | 95851 | 04413 | 36 | 95587 | 00264 | 0 | 99736 | 41 |
| 20 | 11 9 20 | 0 50 40 | 9.04262 | 37 | 10.95738 | 9.04528 | 38 | 10.95472 | 10.00266 | 0 | 9.99734 | 40 |
| 21 | 9 12 | 50 48 | 04376 | 39 | 95624 | 04643 | 39 | 95357 | 00267 | 1 | 99733 | 39 |
| 22 | 9 4 | 50 56 | 04490 | 41 | 95510 | 04758 | 41 | 95242 | 00269 | 1 | 99731 | 38 |
| 23 | 8 56 | 51 4 | 04603 | 43 | 95397 | 04873 | 43 | 95127 | 00270 | 1 | 99730 | 37 |
| 24 | 8 48 | 51 12 | 04715 | 44 | 95285 | 04987 | 45 | 95013 | 00272 | 1 | 99728 | 36 |
| 25 | 11 8 40 | 0 51 20 | 9.04828 | 46 | 10.95172 | 9.05101 | 47 | 10.94899 | 10.00273 | 1 | 9.99727 | 35 |
| 26 | 8 32 | 51 28 | 04940 | 48 | 95060 | 05214 | 49 | 94786 | 00274 | 1 | 99726 | 34 |
| 27 | 8 24 | 51 36 | 05052 | 50 | 94948 | 05328 | 51 | 94672 | 00276 | 1 | 99724 | 33 |
| 28 | 8 16 | 51 44 | 05164 | 52 | 94836 | 05441 | 53 | 94559 | 00277 | 1 | 99723 | 32 |
| 29 | 8 8 | 51 52 | 05275 | 54 | 94725 | 05553 | 54 | 94447 | 00279 | 1 | 99721 | 31 |
| 30 | 11 8 0 | 0 52 0 | 9.05386 | 56 | 10.94614 | 9.05666 | 56 | 10.94334 | 10.00280 | 1 | 9.99720 | 30 |
| 31 | 7 52 | 52 8 | 05497 | 57 | 94503 | 05778 | 58 | 94222 | 00282 | 1 | 99718 | 29 |
| 32 | 7 44 | 52 16 | 05607 | 59 | 94393 | 05890 | 60 | 94110 | 00283 | 1 | 99717 | 28 |
| 33 | 7 36 | 52 24 | 05717 | 61 | 94283 | 06002 | 62 | 93998 | 00284 | 1 | 99716 | 27 |
| 34 | 7 28 | 52 32 | 05827 | 63 | 94173 | 06113 | 64 | 93887 | 00286 | 1 | 99714 | 26 |
| 35 | 11 7 20 | 0 52 40 | 9.05937 | 65 | 10.94063 | 9.06224 | 66 | 10.93776 | 10.00287 | 1 | 9.99713 | 25 |
| 36 | 7 12 | 52 48 | 06046 | 67 | 93954 | 06335 | 68 | 93665 | 00289 | 1 | 99711 | 24 |
| 37 | 7 4 | 52 56 | 06155 | 69 | 93845 | 06445 | 69 | 93555 | 00290 | 1 | 99710 | 23 |
| 38 | 6 56 | 53 4 | 06264 | 70 | 93736 | 06556 | 71 | 93444 | 00292 | 1 | 99708 | 22 |
| 39 | 6 48 | 53 12 | 06372 | 72 | 93628 | 06666 | 73 | 93334 | 00293 | 1 | 99707 | 21 |
| 40 | 11 6 40 | 0 53 20 | 9.06481 | 74 | 10.93519 | 9.06775 | 75 | 10.93225 | 10.00295 | 1 | 9.99705 | 20 |
| 41 | 6 32 | 53 28 | 06589 | 76 | 93411 | 06885 | 77 | 93115 | 00296 | 1 | 99704 | 19 |
| 42 | 6 24 | 53 36 | 06696 | 78 | 93304 | 06994 | 79 | 93006 | 00298 | 1 | 99702 | 18 |
| 43 | 6 16 | 53 44 | 06804 | 80 | 93196 | 07103 | 81 | 92897 | 00299 | 1 | 99701 | 17 |
| 44 | 6 8 | 53 52 | 06911 | 81 | 93089 | 07211 | 83 | 92789 | 00301 | 1 | 99699 | 16 |
| 45 | 11 6 0 | 0 54 0 | 9.07018 | 83 | 10.92982 | 9.07320 | 84 | 10.92680 | 10.00302 | 1 | 9.99698 | 15 |
| 46 | 5 52 | 54 8 | 07124 | 85 | 92876 | 07428 | 86 | 92572 | 00304 | 1 | 99696 | 14 |
| 47 | 5 44 | 54 16 | 07231 | 87 | 92769 | 07536 | 88 | 92464 | 00305 | 1 | 99695 | 13 |
| 48 | 5 36 | 54 24 | 07337 | 89 | 92663 | 07643 | 90 | 92357 | 00307 | 1 | 99693 | 12 |
| 49 | 5 28 | 54 32 | 07442 | 91 | 92558 | 07751 | 92 | 92249 | 00308 | 1 | 99692 | 11 |
| 50 | 11 5 20 | 0 54 40 | 9.07548 | 93 | 10.92452 | 9.07858 | 94 | 10.92142 | 10.00310 | 1 | 9.99690 | 10 |
| 51 | 5 12 | 54 48 | 07653 | 94 | 92347 | 07964 | 96 | 92036 | 00311 | 1 | 99689 | 9 |
| 52 | 5 4 | 54 56 | 07758 | 96 | 92242 | 08071 | 98 | 91929 | 00313 | 1 | 99687 | 8 |
| 53 | 4 56 | 55 4 | 07863 | 98 | 92137 | 08177 | 99 | 91823 | 00314 | 1 | 99686 | 7 |
| 54 | 4 48 | 55 12 | 07968 | 100 | 92032 | 08283 | 101 | 91717 | 00316 | 1 | 99684 | 6 |
| 55 | 11 4 40 | 0 55 20 | 9.08072 | 102 | 10.91928 | 9.08389 | 103 | 10.91611 | 10.00317 | 1 | 9.99683 | 5 |
| 56 | 4 32 | 55 28 | 08176 | 104 | 91824 | 08495 | 105 | 91505 | 00319 | 1 | 99681 | 4 |
| 57 | 4 24 | 55 36 | 08280 | 106 | 91720 | 08600 | 107 | 91400 | 00320 | 1 | 99680 | 3 |
| 58 | 4 16 | 55 44 | 08383 | 107 | 91617 | 08705 | 109 | 91295 | 00322 | 1 | 99678 | 2 |
| 59 | 4 8 | 55 52 | 08486 | 109 | 91514 | 08810 | 111 | 91190 | 00323 | 1 | 99677 | 1 |
| 60 | 4 0 | 56 0 | 08589 | 111 | 91411 | 08914 | 113 | 91086 | 00325 | 1 | 99675 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 11 4 0 | 0 56 0 | 9.08589 | 0 | 10.91411 | 9.08914 | 0 | 10.91086 | 10.00325 | 0 | 9.99675 | 60 |
| 1 | 3 52 | 56 8 | 08602 | 2 | 91308 | 09019 | 2 | 90081 | 00326 | 0 | 99674 | 59 |
| 2 | 3 44 | 56 16 | 08795 | 3 | 91205 | 09123 | 3 | 90877 | 00328 | 0 | 99672 | 58 |
| 3 | 3 36 | 56 24 | 08897 | 5 | 91103 | 09227 | 5 | 90773 | 00330 | 0 | 99670 | 57 |
| 4 | 3 28 | 56 32 | 08999 | 6 | 91001 | 09330 | 7 | 90670 | 00331 | 0 | 99669 | 56 |
| 5 | 11 3 20 | 0 50 40 | 9.09101 | 8 | 10.90899 | 9.09434 | 8 | 10.90566 | 10.00333 | 0 | 9.99667 | 55 |
| 6 | 3 12 | 56 48 | 09202 | 10 | 90798 | 09537 | 10 | 90463 | 00334 | 0 | 99666 | 54 |
| 7 | 3 4 | 56 56 | 09304 | 11 | 90696 | 09640 | 11 | 90360 | 00336 | 0 | 99664 | 53 |
| 8 | 2 56 | 57 4 | 09405 | 13 | 90595 | 09742 | 13 | 90258 | 00337 | 0 | 99663 | 52 |
| 9 | 2 48 | 57 12 | 09506 | 14 | 90494 | 09845 | 15 | 90155 | 00339 | 0 | 99661 | 51 |
| 10 | 11 2 40 | 0 57 20 | 9.09606 | 16 | 10.90394 | 9.09947 | 16 | 10.90053 | 10.00341 | 0 | 9.99659 | 50 |
| 11 | 2 32 | 57 28 | 09707 | 18 | 90293 | 10049 | 18 | 89951 | 00342 | 0 | 99658 | 49 |
| 12 | 2 24 | 57 36 | 09807 | 19 | 90193 | 10150 | 20 | 89850 | 00344 | 0 | 99656 | 48 |
| 13 | 2 16 | 57 44 | 09907 | 21 | 90093 | 10252 | 21 | 89748 | 00345 | 0 | 99655 | 47 |
| 14 | 2 8 | 57 52 | 10006 | 22 | 89994 | 10353 | 23 | 89647 | 00347 | 0 | 99653 | 46 |
| 15 | 11 2 0 | 0 58 0 | 9.10106 | 24 | 10.89894 | 9.10454 | 24 | 10.89546 | 10.00349 | 0 | 9.99651 | 45 |
| 16 | 1 52 | 58 8 | 10205 | 26 | 89795 | 10555 | 26 | 89445 | 00350 | 0 | 99650 | 44 |
| 17 | 1 44 | 58 16 | 10304 | 27 | 89696 | 10656 | 28 | 89344 | 00352 | 0 | 99648 | 43 |
| 18 | 1 36 | 58 24 | 10402 | 29 | 89598 | 10756 | 29 | 89244 | 00353 | 1 | 99647 | 42 |
| 19 | 1 28 | 58 32 | 10501 | 30 | 89499 | 10856 | 31 | 89144 | 00355 | 1 | 99645 | 41 |
| 20 | 11 1 20 | 0 58 40 | 9.10599 | 32 | 10.89401 | 9.10956 | 33 | 10.89044 | 10.00357 | 1 | 9.99643 | 40 |
| 21 | 1 12 | 58 48 | 10697 | 34 | 89303 | 11056 | 34 | 88944 | 00358 | 1 | 99642 | 39 |
| 22 | 1 4 | 58 56 | 10795 | 35 | 89205 | 11155 | 36 | 88845 | 00360 | 1 | 99640 | 38 |
| 23 | 0 56 | 59 4 | 10893 | 37 | 89107 | 11254 | 37 | 88746 | 00362 | 1 | 99638 | 37 |
| 24 | 0 48 | 59 12 | 10990 | 38 | 89010 | 11353 | 39 | 88647 | 00363 | 1 | 99637 | 36 |
| 25 | 11 0 40 | 0 59 20 | 9.11087 | 40 | 10.88913 | 9.11452 | 41 | 10.88548 | 10.00365 | 1 | 9.99635 | 35 |
| 26 | 0 32 | 59 28 | 11184 | 42 | 88816 | 11551 | 42 | 88449 | 00367 | 1 | 99633 | 34 |
| 27 | 0 24 | 59 36 | 11281 | 43 | 88719 | 11649 | 44 | 88351 | 00368 | 1 | 99632 | 33 |
| 28 | 0 16 | 59 44 | 11377 | 45 | 88623 | 11747 | 46 | 88253 | 00370 | 1 | 99630 | 32 |
| 29 | 0 8 | 59 52 | 11474 | 46 | 88526 | 11845 | 47 | 88155 | 00371 | 1 | 99629 | 31 |
| 30 | 11 0 0 | 1 0 0 | 9.11570 | 48 | 10.88430 | 9.11943 | 49 | 10.88057 | 10.00373 | 1 | 9.99627 | 30 |
| 31 | 10 59 52 | 0 8 | 11666 | 50 | 88334 | 12040 | 51 | 87960 | 00375 | 1 | 99625 | 29 |
| 32 | 59 44 | 0 16 | 11761 | 51 | 88239 | 12138 | 52 | 87862 | 00376 | 1 | 99624 | 28 |
| 33 | 59 36 | 0 24 | 11857 | 53 | 88143 | 12235 | 54 | 87765 | 00378 | 1 | 99622 | 27 |
| 34 | 59 28 | 0 32 | 11952 | 54 | 88048 | 12332 | 55 | 87668 | 00380 | 1 | 99620 | 26 |
| 35 | 10 59 20 | 1 0 40 | 9.12047 | 56 | 10.87953 | 9.12428 | 57 | 10.87572 | 10.00382 | 1 | 9.99618 | 25 |
| 36 | 59 12 | 0 48 | 12142 | 58 | 87858 | 12525 | 59 | 87475 | 00383 | 1 | 99617 | 24 |
| 37 | 59 4 | 0 56 | 12236 | 59 | 87764 | 12621 | 60 | 87379 | 00385 | 1 | 99615 | 23 |
| 38 | 58 56 | 1 4 | 12331 | 61 | 87669 | 12717 | 62 | 87283 | 00387 | 1 | 99613 | 22 |
| 39 | 58 48 | 1 12 | 12425 | 62 | 87575 | 12813 | 64 | 87187 | 00388 | 1 | 99612 | 21 |
| 40 | 10 58 40 | 1 1 20 | 9.12519 | 64 | 10.87481 | 9.12909 | 65 | 10.87091 | 10.00390 | 1 | 9.99610 | 20 |
| 41 | 58 32 | 1 28 | 12612 | 66 | 87388 | 13004 | 67 | 86996 | 00392 | 1 | 99608 | 19 |
| 42 | 58 24 | 1 36 | 12706 | 67 | 87294 | 13099 | 68 | 86901 | 00393 | 1 | 99607 | 18 |
| 43 | 58 16 | 1 44 | 12799 | 69 | 87201 | 13194 | 70 | 86806 | 00395 | 1 | 99605 | 17 |
| 44 | 58 8 | 1 52 | 12892 | 70 | 87108 | 13289 | 72 | 86711 | 00397 | 1 | 99603 | 16 |
| 45 | 10 58 0 | 1 2 0 | 9.12985 | 72 | 10.87015 | 9.13384 | 73 | 10.86616 | 10.00399 | 1 | 9.99601 | 15 |
| 46 | 57 52 | 2 8 | 13078 | 74 | 86922 | 13478 | 75 | 86522 | 00400 | 1 | 99600 | 14 |
| 47 | 57 44 | 2 16 | 13171 | 75 | 86829 | 13573 | 77 | 86427 | 00402 | 1 | 99598 | 13 |
| 48 | 57 36 | 2 24 | 13263 | 77 | 86737 | 13667 | 78 | 86333 | 00404 | 1 | 99596 | 12 |
| 49 | 57 28 | 2 32 | 13355 | 78 | 86645 | 13761 | 80 | 86239 | 00405 | 1 | 99595 | 11 |
| 50 | 10 57 20 | 1 2 40 | 9.13447 | 80 | 10.86553 | 9.13854 | 81 | 10.86146 | 10.00407 | 1 | 9.99593 | 10 |
| 51 | 57 12 | 2 48 | 13539 | 82 | 86461 | 13948 | 83 | 86052 | 00409 | 1 | 99591 | 9 |
| 52 | 57 4 | 2 56 | 13630 | 83 | 86370 | 14041 | 85 | 85959 | 00411 | 1 | 99589 | 8 |
| 53 | 56 56 | 3 4 | 13722 | 85 | 86278 | 14134 | 86 | 85866 | 00412 | 1 | 99588 | 7 |
| 54 | 56 48 | 3 12 | 13813 | 87 | 86187 | 14227 | 88 | 85773 | 00414 | 2 | 99586 | 6 |
| 55 | 10 56 40 | 1 3 20 | 9.13904 | 88 | 10.86066 | 9.14320 | 90 | 10.85680 | 10.00416 | 2 | 9.99584 | 5 |
| 56 | 56 32 | 3 28 | 13994 | 90 | 86006 | 14412 | 91 | 85588 | 00418 | 2 | 99582 | 4 |
| 57 | 56 24 | 3 36 | 14085 | 91 | 85915 | 14504 | 93 | 85496 | 00419 | 2 | 99581 | 3 |
| 58 | 56 16 | 3 44 | 14175 | 93 | 85825 | 14597 | 95 | 85403 | 00421 | 2 | 99579 | 2 |
| 59 | 56 8 | 3 52 | 14266 | 95 | 85734 | 14688 | 96 | 85312 | 00423 | 2 | 99577 | 1 |
| 60 | 56 0 | 4 0 | 14356 | 96 | 85644 | 14780 | 98 | 85220 | 00425 | 2 | 99575 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|----------|-------|------------|----------|-------|---------|----|
| 0 | 10 56 0 | 1 4 0 | 9.14356 | 0 | 10.85644 | 9.14780 | 0 | 10.85220 | 10.00425 | 0 | 9.99575 | 60 |
| 1 | 55 52 | 4 8 | 14445 | 1 | 85555 | 14872 | 1 | 85128 | 00426 | 0 | 99574 | 59 |
| 2 | 55 44 | 4 16 | 14535 | 3 | 85465 | 14963 | 3 | 85037 | 00428 | 0 | 99572 | 58 |
| 3 | 55 36 | 4 24 | 14624 | 4 | 85376 | 15054 | 4 | 84946 | 00430 | 0 | 99570 | 57 |
| 4 | 55 28 | 4 32 | 14714 | 6 | 85286 | 15147 | 6 | 84855 | 00432 | 0 | 99568 | 56 |
| 5 | 55 20 | 4 40 | 9.14803 | 7 | 10.85197 | 9.15236 | 7 | 10.84764 | 10.00434 | 0 | 9.99566 | 55 |
| 6 | 55 12 | 4 48 | 14891 | 8 | 85109 | 15327 | 9 | 84673 | 00435 | 0 | 99565 | 54 |
| 7 | 55 4 | 4 56 | 14980 | 10 | 85020 | 15417 | 10 | 84583 | 00437 | 0 | 99563 | 53 |
| 8 | 54 56 | 5 4 | 15069 | 11 | 84931 | 15508 | 12 | 84492 | 00439 | 0 | 99561 | 52 |
| 9 | 54 48 | 5 12 | 15157 | 13 | 84843 | 15598 | 13 | 84402 | 00441 | 0 | 99559 | 51 |
| 10 | 54 40 | 5 20 | 9.15245 | 14 | 10.84755 | 9.15688 | 14 | 10.84312 | 10.00443 | 0 | 9.99557 | 50 |
| 11 | 54 32 | 5 28 | 15333 | 16 | 84667 | 15777 | 16 | 84223 | 00444 | 0 | 99556 | 49 |
| 12 | 54 24 | 5 36 | 15421 | 17 | 84579 | 15867 | 17 | 84133 | 00446 | 0 | 99554 | 48 |
| 13 | 54 16 | 5 44 | 15508 | 18 | 84492 | 15956 | 19 | 84044 | 00448 | 0 | 99552 | 47 |
| 14 | 54 8 | 5 52 | 15596 | 20 | 84404 | 16046 | 20 | 83954 | 00450 | 0 | 99550 | 46 |
| 15 | 54 0 | 6 0 | 9.15683 | 21 | 10.84317 | 9.16135 | 22 | 10.83865 | 10.00452 | 0 | 9.99548 | 45 |
| 16 | 53 52 | 6 8 | 15770 | 23 | 84230 | 16224 | 23 | 83770 | 00454 | 1 | 99546 | 44 |
| 17 | 53 44 | 6 16 | 15857 | 24 | 84143 | 16312 | 25 | 83688 | 00455 | 1 | 99545 | 43 |
| 18 | 53 36 | 6 24 | 15944 | 25 | 84056 | 16401 | 26 | 83599 | 00457 | 1 | 99543 | 42 |
| 19 | 53 28 | 6 32 | 16030 | 27 | 83970 | 16489 | 27 | 83511 | 00459 | 1 | 99541 | 41 |
| 20 | 53 20 | 6 40 | 9.16116 | 28 | 10.83884 | 9.16577 | 29 | 10.83423 | 10.00461 | 1 | 9.99539 | 40 |
| 21 | 53 12 | 6 48 | 16203 | 30 | 83797 | 16665 | 30 | 83335 | 00463 | 1 | 99537 | 39 |
| 22 | 53 4 | 6 56 | 16289 | 31 | 83711 | 16753 | 32 | 83247 | 00465 | 1 | 99535 | 38 |
| 23 | 52 56 | 7 4 | 16374 | 32 | 83626 | 16841 | 33 | 83159 | 00467 | 1 | 99533 | 37 |
| 24 | 52 48 | 7 12 | 16460 | 34 | 83540 | 16928 | 35 | 83072 | 00468 | 1 | 99532 | 36 |
| 25 | 52 40 | 7 20 | 9.16545 | 35 | 10.83455 | 9.17016 | 36 | 10.82984 | 10.00470 | 1 | 9.99530 | 35 |
| 26 | 52 32 | 7 28 | 16631 | 37 | 83369 | 17103 | 37 | 82897 | 00472 | 1 | 99528 | 34 |
| 27 | 52 24 | 7 36 | 16716 | 38 | 83284 | 17190 | 39 | 82810 | 00474 | 1 | 99526 | 33 |
| 28 | 52 16 | 7 44 | 16801 | 39 | 83199 | 17277 | 40 | 82723 | 00476 | 1 | 99524 | 32 |
| 29 | 52 8 | 7 52 | 16886 | 41 | 83114 | 17363 | 42 | 82637 | 00478 | 1 | 99522 | 31 |
| 30 | 52 0 | 8 0 | 9.16970 | 42 | 10.83030 | 9.17450 | 43 | 10.82550 | 10.00480 | 1 | 9.99520 | 30 |
| 31 | 51 52 | 8 8 | 17055 | 44 | 82945 | 17536 | 45 | 82464 | 00482 | 1 | 99518 | 29 |
| 32 | 51 44 | 8 16 | 17139 | 45 | 82861 | 17622 | 46 | 82378 | 00483 | 1 | 99517 | 28 |
| 33 | 51 36 | 8 24 | 17223 | 47 | 82777 | 17708 | 48 | 82292 | 00485 | 1 | 99515 | 27 |
| 34 | 51 28 | 8 32 | 17307 | 48 | 82693 | 17794 | 49 | 82206 | 00487 | 1 | 99513 | 26 |
| 35 | 51 20 | 8 40 | 9.17391 | 49 | 10.82609 | 9.17880 | 50 | 10.82120 | 10.00489 | 1 | 9.99511 | 25 |
| 36 | 51 12 | 8 48 | 17474 | 51 | 82526 | 17965 | 52 | 82035 | 00491 | 1 | 99509 | 24 |
| 37 | 51 4 | 8 56 | 17558 | 52 | 82442 | 18051 | 53 | 81949 | 00493 | 1 | 99507 | 23 |
| 38 | 50 56 | 9 4 | 17641 | 54 | 82359 | 18136 | 55 | 81864 | 00495 | 1 | 99505 | 22 |
| 39 | 50 48 | 9 12 | 17724 | 55 | 82276 | 18221 | 56 | 81779 | 00497 | 1 | 99503 | 21 |
| 40 | 50 40 | 9 20 | 9.17807 | 56 | 10.82193 | 9.18306 | 58 | 10.81694 | 10.00499 | 1 | 9.99501 | 20 |
| 41 | 50 32 | 9 28 | 17890 | 58 | 82110 | 18391 | 59 | 81609 | 00501 | 1 | 99499 | 19 |
| 42 | 50 24 | 9 36 | 17973 | 59 | 82027 | 18475 | 61 | 81525 | 00503 | 1 | 99497 | 18 |
| 43 | 50 16 | 9 44 | 18055 | 61 | 81945 | 18560 | 62 | 81440 | 00505 | 1 | 99495 | 17 |
| 44 | 50 8 | 9 52 | 18137 | 62 | 81863 | 18644 | 63 | 81356 | 00506 | 1 | 99494 | 16 |
| 45 | 50 0 | 10 0 | 9.18220 | 63 | 10.81783 | 9.18728 | 65 | 10.81272 | 10.00508 | 1 | 9.99492 | 15 |
| 46 | 49 52 | 10 8 | 18302 | 65 | 81698 | 18812 | 66 | 81188 | 00510 | 1 | 99490 | 14 |
| 47 | 49 44 | 10 16 | 18383 | 66 | 81617 | 18896 | 68 | 81104 | 00512 | 1 | 99488 | 13 |
| 48 | 49 36 | 10 24 | 18465 | 68 | 81535 | 18979 | 69 | 81021 | 00514 | 2 | 99486 | 12 |
| 49 | 49 28 | 10 32 | 18547 | 69 | 81453 | 19063 | 71 | 80937 | 00516 | 2 | 99484 | 11 |
| 50 | 49 20 | 10 40 | 9.18628 | 71 | 10.81372 | 9.19146 | 72 | 10.80854 | 10.00518 | 2 | 9.99482 | 10 |
| 51 | 49 12 | 10 48 | 18709 | 72 | 81291 | 19229 | 74 | 80771 | 00520 | 2 | 99480 | 9 |
| 52 | 49 4 | 10 56 | 18790 | 73 | 81210 | 19312 | 75 | 80688 | 00522 | 2 | 99478 | 8 |
| 53 | 48 56 | 11 4 | 18871 | 75 | 81129 | 19395 | 76 | 80605 | 00524 | 2 | 99476 | 7 |
| 54 | 48 48 | 11 12 | 18952 | 76 | 81048 | 19478 | 78 | 80522 | 00526 | 2 | 99474 | 6 |
| 55 | 48 40 | 11 20 | 9.19033 | 78 | 10.80967 | 9.19561 | 79 | 10.80439 | 10.00528 | 2 | 9.99472 | 5 |
| 56 | 48 32 | 11 28 | 19113 | 79 | 80887 | 19643 | 81 | 80357 | 00530 | 2 | 99470 | 4 |
| 57 | 48 24 | 11 36 | 19193 | 80 | 80807 | 19725 | 82 | 80275 | 00532 | 2 | 99468 | 3 |
| 58 | 48 16 | 11 44 | 19273 | 82 | 80727 | 19807 | 84 | 80193 | 00534 | 2 | 99466 | 2 |
| 59 | 48 8 | 11 52 | 19353 | 83 | 80647 | 19889 | 85 | 80111 | 00536 | 2 | 99464 | 1 |
| 60 | 48 0 | 12 0 | 19433 | 85 | 80567 | 19971 | 87 | 80029 | 00538 | 2 | 99462 | 0 |

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|

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SINES, TANGENTS, AND SECANTS.

| | | | | | | | | | | | | | 170° |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|------|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | |
| 0 | 10 48 0 | 1 12 0 | 9. 19433 | 0 | 10. 80567 | 9. 19971 | 0 | 10. 80029 | 10. 00538 | 0 | 9. 99462 | 60 | |
| 1 | 47 52 | 12 8 | 19513 | 1 | 80487 | 20053 | 1 | 79947 | 00540 | 0 | 99460 | 59 | |
| 2 | 47 44 | 12 16 | 19592 | 3 | 80408 | 20134 | 3 | 79865 | 00542 | 0 | 99458 | 58 | |
| 3 | 47 36 | 12 24 | 19672 | 4 | 80328 | 20216 | 4 | 79784 | 00544 | 0 | 99456 | 57 | |
| 4 | 47 28 | 12 32 | 19751 | 5 | 80249 | 20297 | 5 | 79703 | 00546 | 0 | 99454 | 56 | |
| 5 | 10 47 20 | 1 12 40 | 9. 19830 | 6 | 10. 80170 | 9. 20378 | 6 | 10. 79622 | 10. 00548 | 0 | 9. 99452 | 55 | |
| 6 | 47 12 | 12 48 | 19909 | 8 | 80091 | 20459 | 8 | 79541 | 00550 | 0 | 99450 | 54 | |
| 7 | 47 4 | 12 56 | 19988 | 9 | 80012 | 20540 | 9 | 79460 | 00552 | 0 | 99448 | 53 | |
| 8 | 46 56 | 13 4 | 20067 | 10 | 79933 | 20621 | 10 | 79379 | 00554 | 0 | 99446 | 52 | |
| 9 | 46 48 | 13 12 | 20145 | 11 | 79855 | 20701 | 12 | 79299 | 00556 | 0 | 99444 | 51 | |
| 10 | 10 46 40 | 1 13 20 | 9. 20223 | 13 | 10. 79777 | 9. 20782 | 13 | 10. 79218 | 10. 00558 | 0 | 9. 99442 | 50 | |
| 11 | 46 32 | 13 28 | 20302 | 14 | 79698 | 20862 | 14 | 79138 | 00560 | 0 | 99440 | 49 | |
| 12 | 46 24 | 13 36 | 20380 | 15 | 79620 | 20942 | 16 | 79058 | 00562 | 0 | 99438 | 48 | |
| 13 | 46 16 | 13 44 | 20458 | 16 | 79542 | 21022 | 17 | 78978 | 00564 | 0 | 99436 | 47 | |
| 14 | 46 8 | 13 52 | 20535 | 18 | 79465 | 21102 | 18 | 78898 | 00566 | 0 | 99434 | 46 | |
| 15 | 10 45 0 | 1 14 0 | 9. 20613 | 19 | 10. 79387 | 9. 21182 | 19 | 10. 78818 | 10. 00568 | 1 | 9. 99432 | 45 | |
| 16 | 45 52 | 14 8 | 20691 | 20 | 79309 | 21261 | 21 | 78739 | 00571 | 1 | 99429 | 44 | |
| 17 | 45 44 | 14 16 | 20768 | 21 | 79232 | 21341 | 22 | 78659 | 00573 | 1 | 99427 | 43 | |
| 18 | 45 36 | 14 24 | 20845 | 23 | 79155 | 21420 | 23 | 78580 | 00575 | 1 | 99425 | 42 | |
| 19 | 45 28 | 14 32 | 20922 | 24 | 79078 | 21499 | 25 | 78501 | 00577 | 1 | 99423 | 41 | |
| 20 | 10 45 20 | 1 14 40 | 9. 20999 | 25 | 10. 79001 | 9. 21578 | 26 | 10. 78422 | 10. 00579 | 1 | 9. 99421 | 40 | |
| 21 | 45 12 | 14 48 | 21076 | 26 | 78924 | 21657 | 27 | 78343 | 00581 | 1 | 99419 | 39 | |
| 22 | 45 4 | 14 56 | 21153 | 28 | 78847 | 21736 | 28 | 78264 | 00583 | 1 | 99417 | 38 | |
| 23 | 44 56 | 15 4 | 21229 | 29 | 78771 | 21814 | 30 | 78186 | 00585 | 1 | 99415 | 37 | |
| 24 | 44 48 | 15 12 | 21306 | 30 | 78694 | 21893 | 31 | 78107 | 00587 | 1 | 99413 | 36 | |
| 25 | 10 44 40 | 1 15 20 | 9. 21382 | 31 | 10. 78618 | 9. 21971 | 32 | 10. 78029 | 10. 00589 | 1 | 9. 99411 | 35 | |
| 26 | 44 32 | 15 28 | 21458 | 33 | 78542 | 22049 | 34 | 77951 | 00591 | 1 | 99409 | 34 | |
| 27 | 44 24 | 15 36 | 21534 | 34 | 78466 | 22127 | 35 | 77873 | 00593 | 1 | 99407 | 33 | |
| 28 | 44 16 | 15 44 | 21610 | 35 | 78390 | 22205 | 36 | 77795 | 00596 | 1 | 99404 | 32 | |
| 29 | 44 8 | 15 52 | 21685 | 37 | 78315 | 22283 | 38 | 77717 | 00598 | 1 | 99402 | 31 | |
| 30 | 10 44 0 | 1 16 0 | 9. 21761 | 38 | 10. 78239 | 9. 22361 | 39 | 10. 77639 | 10. 00600 | 1 | 9. 99400 | 30 | |
| 31 | 43 52 | 16 8 | 21836 | 39 | 78164 | 22438 | 40 | 77562 | 00602 | 1 | 99398 | 29 | |
| 32 | 43 44 | 16 16 | 21912 | 40 | 78088 | 22516 | 41 | 77484 | 00604 | 1 | 99396 | 28 | |
| 33 | 43 36 | 16 24 | 21987 | 42 | 78013 | 22593 | 43 | 77407 | 00606 | 1 | 99394 | 27 | |
| 34 | 43 28 | 16 32 | 22062 | 43 | 77938 | 22670 | 44 | 77330 | 00608 | 1 | 99392 | 26 | |
| 35 | 10 43 20 | 1 16 40 | 9. 22137 | 44 | 10. 77863 | 9. 22747 | 45 | 10. 77253 | 10. 00610 | 1 | 9. 99390 | 25 | |
| 36 | 43 12 | 16 48 | 22211 | 45 | 77789 | 22824 | 47 | 77176 | 00612 | 1 | 99388 | 24 | |
| 37 | 43 4 | 16 56 | 22286 | 47 | 77714 | 22901 | 48 | 77099 | 00615 | 1 | 99385 | 23 | |
| 38 | 42 56 | 17 4 | 22361 | 48 | 77639 | 22977 | 49 | 77023 | 00617 | 1 | 99383 | 22 | |
| 39 | 42 48 | 17 12 | 22435 | 49 | 77565 | 23054 | 50 | 76946 | 00619 | 1 | 99381 | 21 | |
| 40 | 10 42 40 | 1 17 20 | 9. 22509 | 50 | 10. 77491 | 9. 23130 | 52 | 10. 76870 | 10. 00621 | 1 | 9. 99379 | 20 | |
| 41 | 42 32 | 17 28 | 22583 | 52 | 77417 | 23206 | 53 | 76794 | 00623 | 1 | 99377 | 19 | |
| 42 | 42 24 | 17 36 | 22657 | 53 | 77343 | 23283 | 54 | 76717 | 00625 | 1 | 99375 | 18 | |
| 43 | 42 16 | 17 44 | 22731 | 54 | 77269 | 23359 | 56 | 76641 | 00628 | 2 | 99372 | 17 | |
| 44 | 42 8 | 17 52 | 22805 | 55 | 77195 | 23435 | 57 | 76565 | 00630 | 2 | 99370 | 16 | |
| 45 | 10 42 0 | 1 18 0 | 9. 22878 | 57 | 10. 77122 | 9. 23510 | 58 | 10. 76490 | 10. 00632 | 2 | 9. 99368 | 15 | |
| 46 | 41 52 | 18 8 | 22952 | 58 | 77048 | 23586 | 60 | 76414 | 00634 | 2 | 99366 | 14 | |
| 47 | 41 44 | 18 16 | 23025 | 59 | 76975 | 23661 | 61 | 76339 | 00636 | 2 | 99364 | 13 | |
| 48 | 41 36 | 18 24 | 23098 | 60 | 76902 | 23737 | 62 | 76263 | 00638 | 2 | 99362 | 12 | |
| 49 | 41 28 | 18 32 | 23171 | 62 | 76829 | 23812 | 63 | 76188 | 00641 | 2 | 99359 | 11 | |
| 50 | 10 41 20 | 1 18 40 | 9. 23244 | 63 | 10. 76756 | 9. 23887 | 65 | 10. 76113 | 10. 00643 | 2 | 9. 99357 | 10 | |
| 51 | 41 12 | 18 48 | 23317 | 64 | 76683 | 23962 | 66 | 76038 | 00645 | 2 | 99355 | 9 | |
| 52 | 41 4 | 18 56 | 23390 | 65 | 76610 | 24037 | 67 | 75963 | 00647 | 2 | 99353 | 8 | |
| 53 | 40 56 | 19 4 | 23462 | 67 | 76538 | 24112 | 69 | 75888 | 00649 | 2 | 99351 | 7 | |
| 54 | 40 48 | 19 12 | 23535 | 68 | 76465 | 24186 | 70 | 75814 | 00652 | 2 | 99348 | 6 | |
| 55 | 10 40 40 | 1 19 20 | 9. 23607 | 69 | 10. 76393 | 9. 24261 | 71 | 10. 75739 | 10. 00654 | 2 | 9. 99346 | 5 | |
| 56 | 40 32 | 19 28 | 23679 | 71 | 76321 | 24335 | 73 | 75665 | 00656 | 2 | 99344 | 4 | |
| 57 | 40 24 | 19 36 | 23752 | 72 | 76248 | 24410 | 74 | 75590 | 00658 | 2 | 99342 | 3 | |
| 58 | 40 16 | 19 44 | 23823 | 73 | 76177 | 24484 | 75 | 75516 | 00660 | 2 | 99340 | 2 | |
| 59 | 40 8 | 19 52 | 23895 | 74 | 76105 | 24558 | 76 | 75442 | 00663 | 2 | 99337 | 1 | |
| 60 | 40 0 | 20 0 | 23967 | 76 | 76033 | 24632 | 78 | 75368 | 00665 | 2 | 99335 | 0 | |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. | |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 10 40 0 | 1 20 0 | 9. 23967 | 0 | 10. 76033 | 9. 24632 | 0 | 10. 75368 | 10. 00665 | 0 | 9. 99335 | 60 |
| 1 | 39 52 | 20 8 | 24039 | 1 | 75961 | 24706 | 1 | 75294 | 00667 | 0 | 99333 | 59 |
| 2 | 39 44 | 20 16 | 24110 | 2 | 75890 | 24779 | 2 | 75221 | 00669 | 0 | 99331 | 58 |
| 3 | 39 36 | 20 24 | 24181 | 3 | 75819 | 24851 | 3 | 75147 | 00672 | 0 | 99328 | 57 |
| 4 | 39 28 | 20 32 | 24253 | 5 | 75747 | 24926 | 5 | 75074 | 00674 | 0 | 99326 | 56 |
| 5 | 10 39 20 | 1 20 40 | 9. 24324 | 6 | 10. 75676 | 9. 25000 | 6 | 10. 75000 | 10. 00676 | 0 | 9. 99324 | 55 |
| 6 | 39 12 | 20 48 | 24395 | 7 | 75605 | 25073 | 7 | 74927 | 00678 | 0 | 99322 | 54 |
| 7 | 39 4 | 20 56 | 24466 | 8 | 75534 | 25146 | 8 | 74854 | 00681 | 0 | 99319 | 53 |
| 8 | 38 56 | 21 4 | 24536 | 9 | 75464 | 25219 | 9 | 74781 | 00683 | 0 | 99317 | 52 |
| 9 | 38 48 | 21 12 | 24607 | 10 | 75393 | 25292 | 11 | 74708 | 00685 | 0 | 99315 | 51 |
| 10 | 10 38 40 | 1 21 20 | 9. 24677 | 11 | 10. 75323 | 9. 25305 | 12 | 10. 74635 | 10. 00687 | 0 | 9. 99313 | 50 |
| 11 | 38 32 | 21 28 | 24748 | 13 | 75252 | 25437 | 13 | 74563 | 00690 | 0 | 99310 | 49 |
| 12 | 38 24 | 21 36 | 24818 | 14 | 75182 | 25510 | 14 | 74490 | 00692 | 0 | 99308 | 48 |
| 13 | 38 16 | 21 44 | 24888 | 15 | 75112 | 25582 | 15 | 74418 | 00694 | 1 | 99306 | 47 |
| 14 | 38 8 | 21 52 | 24958 | 16 | 75042 | 25655 | 16 | 74345 | 00696 | 1 | 99304 | 46 |
| 15 | 10 38 0 | 1 22 0 | 9. 25028 | 17 | 10. 74972 | 9. 25727 | 18 | 10. 74273 | 10. 00699 | 1 | 9. 99301 | 45 |
| 16 | 37 52 | 22 8 | 25098 | 18 | 74902 | 25799 | 19 | 74201 | 00701 | 1 | 99299 | 44 |
| 17 | 37 44 | 22 16 | 25168 | 19 | 74832 | 25871 | 20 | 74129 | 00703 | 1 | 99297 | 43 |
| 18 | 37 36 | 22 24 | 25237 | 20 | 74763 | 25943 | 21 | 74057 | 00706 | 1 | 99294 | 42 |
| 19 | 37 28 | 22 32 | 25307 | 22 | 74693 | 26015 | 22 | 73985 | 00708 | 1 | 99292 | 41 |
| 20 | 10 37 20 | 1 22 40 | 9. 25376 | 23 | 10. 74624 | 9. 26086 | 24 | 10. 73914 | 10. 00710 | 1 | 9. 99290 | 40 |
| 21 | 37 12 | 22 48 | 25445 | 24 | 74555 | 26158 | 25 | 73842 | 00712 | 1 | 99288 | 39 |
| 22 | 37 4 | 22 56 | 25514 | 25 | 74486 | 26229 | 26 | 73771 | 00715 | 1 | 99285 | 38 |
| 23 | 36 56 | 23 4 | 25583 | 26 | 74417 | 26301 | 27 | 73699 | 00717 | 1 | 99283 | 37 |
| 24 | 36 48 | 23 12 | 25652 | 27 | 74348 | 26372 | 28 | 73628 | 00719 | 1 | 99281 | 36 |
| 25 | 10 36 40 | 1 23 20 | 9. 25721 | 28 | 10. 74279 | 9. 26443 | 29 | 10. 73557 | 10. 00722 | 1 | 9. 99278 | 35 |
| 26 | 36 32 | 23 28 | 25790 | 30 | 74210 | 26514 | 31 | 73486 | 00724 | 1 | 99276 | 34 |
| 27 | 36 24 | 23 36 | 25858 | 31 | 74142 | 26585 | 32 | 73415 | 00726 | 1 | 99274 | 33 |
| 28 | 36 16 | 23 44 | 25927 | 32 | 74073 | 26655 | 33 | 73345 | 00729 | 1 | 99271 | 32 |
| 29 | 36 8 | 23 52 | 25995 | 33 | 74005 | 26726 | 34 | 73274 | 00731 | 1 | 99269 | 31 |
| 30 | 10 36 0 | 1 24 0 | 9. 26063 | 34 | 10. 73937 | 9. 26797 | 35 | 10. 73203 | 10. 00733 | 1 | 9. 99267 | 30 |
| 31 | 35 52 | 24 8 | 26131 | 35 | 73869 | 26867 | 36 | 73133 | 00736 | 1 | 99264 | 29 |
| 32 | 35 44 | 24 16 | 26199 | 36 | 73801 | 26937 | 38 | 73063 | 00738 | 1 | 99262 | 28 |
| 33 | 35 36 | 24 24 | 26267 | 38 | 73733 | 27008 | 39 | 72992 | 00740 | 1 | 99260 | 27 |
| 34 | 35 28 | 24 32 | 26335 | 39 | 73665 | 27078 | 40 | 72922 | 00743 | 1 | 99257 | 26 |
| 35 | 10 35 20 | 1 24 40 | 9. 26403 | 40 | 10. 73597 | 9. 27148 | 41 | 10. 72852 | 10. 00745 | 1 | 9. 99255 | 25 |
| 36 | 35 12 | 24 48 | 26470 | 41 | 73530 | 27218 | 42 | 72782 | 00748 | 1 | 99252 | 24 |
| 37 | 35 4 | 24 56 | 26538 | 42 | 73462 | 27288 | 44 | 72712 | 00750 | 1 | 99250 | 23 |
| 38 | 34 56 | 25 4 | 26605 | 43 | 73395 | 27357 | 45 | 72643 | 00752 | 1 | 99248 | 22 |
| 39 | 34 48 | 25 12 | 26672 | 44 | 73328 | 27427 | 46 | 72573 | 00755 | 2 | 99245 | 21 |
| 40 | 10 34 40 | 1 25 20 | 9. 26739 | 45 | 10. 73261 | 9. 27496 | 47 | 10. 72504 | 10. 00757 | 2 | 9. 99243 | 20 |
| 41 | 34 32 | 25 28 | 26806 | 47 | 73194 | 27566 | 48 | 72434 | 00759 | 2 | 99241 | 19 |
| 42 | 34 24 | 25 36 | 26873 | 48 | 73127 | 27635 | 49 | 72365 | 00762 | 2 | 99238 | 18 |
| 43 | 34 16 | 25 44 | 26940 | 49 | 73060 | 27704 | 51 | 72296 | 00764 | 2 | 99236 | 17 |
| 44 | 34 8 | 25 52 | 27007 | 50 | 72993 | 27773 | 52 | 72227 | 00767 | 2 | 99233 | 16 |
| 45 | 10 34 0 | 1 26 0 | 9. 27073 | 51 | 10. 72927 | 9. 27842 | 53 | 10. 72158 | 10. 00769 | 2 | 9. 99231 | 15 |
| 46 | 33 52 | 26 8 | 27140 | 52 | 72860 | 27911 | 54 | 72089 | 00771 | 2 | 99229 | 14 |
| 47 | 33 44 | 26 16 | 27206 | 53 | 72794 | 27980 | 55 | 72020 | 00774 | 2 | 99226 | 13 |
| 48 | 33 36 | 26 24 | 27273 | 55 | 72727 | 28049 | 56 | 71951 | 00776 | 2 | 99224 | 12 |
| 49 | 33 28 | 26 32 | 27339 | 56 | 72661 | 28117 | 58 | 71883 | 00779 | 2 | 99221 | 11 |
| 50 | 10 33 20 | 1 26 40 | 9. 27405 | 57 | 10. 72595 | 9. 28186 | 59 | 10. 71814 | 10. 00781 | 2 | 9. 99219 | 10 |
| 51 | 33 12 | 26 48 | 27471 | 58 | 72529 | 28254 | 60 | 71746 | 00783 | 2 | 99217 | 9 |
| 52 | 33 4 | 26 56 | 27537 | 59 | 72463 | 28323 | 61 | 71677 | 00786 | 2 | 99214 | 8 |
| 53 | 32 56 | 27 4 | 27602 | 60 | 72398 | 28391 | 62 | 71609 | 00788 | 2 | 99212 | 7 |
| 54 | 32 48 | 27 12 | 27668 | 61 | 72332 | 28459 | 63 | 71541 | 00791 | 2 | 99209 | 6 |
| 55 | 10 32 40 | 1 27 20 | 9. 27734 | 63 | 10. 72266 | 9. 28527 | 65 | 10. 71473 | 10. 00793 | 2 | 9. 99207 | 5 |
| 56 | 32 32 | 27 28 | 27799 | 64 | 72201 | 28595 | 66 | 71405 | 00796 | 2 | 99204 | 4 |
| 57 | 32 24 | 27 36 | 27864 | 65 | 72136 | 28662 | 67 | 71338 | 00798 | 2 | 99202 | 3 |
| 58 | 32 16 | 27 44 | 27930 | 66 | 72070 | 28730 | 68 | 71270 | 00800 | 2 | 99200 | 2 |
| 59 | 32 8 | 27 52 | 27995 | 67 | 72005 | 28798 | 69 | 71202 | 00803 | 2 | 99197 | 1 |
| 60 | 32 0 | 28 0 | 28060 | 68 | 71940 | 28865 | 71 | 71135 | 00805 | 2 | 99195 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|----------|-------|------------|-----------|-------|----------|----|
| 0 | 10 32 0 | 1 28 0 | 9. 28060 | 0 | 10. 71940 | 9. 28865 | 0 | 10. 71135 | 10. 00805 | 0 | 9. 99195 | 60 |
| 1 | 31 52 | 28 8 | 28125 | 1 | 71875 | 28933 | 1 | 71067 | 00808 | 0 | 99192 | 59 |
| 2 | 31 44 | 28 16 | 28190 | 2 | 71810 | 29000 | 2 | 71000 | 00810 | 0 | 99190 | 58 |
| 3 | 31 36 | 28 24 | 28254 | 3 | 71746 | 29067 | 3 | 70933 | 00813 | 0 | 99187 | 57 |
| 4 | 31 28 | 28 32 | 28319 | 4 | 71681 | 29134 | 4 | 70866 | 00815 | 0 | 99185 | 56 |
| 5 | 10 31 20 | 1 28 40 | 9. 28384 | 5 | 10. 71616 | 9. 29201 | 5 | 10. 70799 | 10. 00818 | 0 | 9. 99182 | 55 |
| 6 | 31 12 | 28 48 | 28448 | 6 | 71552 | 29268 | 6 | 70732 | 00820 | 0 | 99180 | 54 |
| 7 | 31 4 | 28 56 | 28512 | 7 | 71488 | 29335 | 8 | 70665 | 00823 | 0 | 99177 | 53 |
| 8 | 30 56 | 29 4 | 28577 | 8 | 71423 | 29402 | 9 | 70598 | 00825 | 0 | 99175 | 52 |
| 9 | 30 48 | 29 12 | 28641 | 9 | 71359 | 29468 | 10 | 70532 | 00828 | 0 | 99172 | 51 |
| 10 | 10 30 40 | 1 29 20 | 9. 28705 | 10 | 10. 71295 | 9. 29535 | 11 | 10. 70465 | 10. 00830 | 0 | 9. 99170 | 50 |
| 11 | 30 32 | 29 28 | 28769 | 11 | 71231 | 29601 | 12 | 70399 | 00833 | 0 | 99167 | 49 |
| 12 | 30 24 | 29 36 | 28833 | 12 | 71167 | 29668 | 13 | 70332 | 00835 | 1 | 99165 | 48 |
| 13 | 30 16 | 29 44 | 28896 | 13 | 71104 | 29734 | 14 | 70266 | 00838 | 1 | 99162 | 47 |
| 14 | 30 8 | 29 52 | 28960 | 14 | 71040 | 29800 | 15 | 70200 | 00840 | 1 | 99160 | 46 |
| 15 | 10 30 0 | 1 30 0 | 9. 29024 | 16 | 10. 70976 | 9. 29866 | 16 | 10. 70134 | 10. 00843 | 1 | 9. 99157 | 45 |
| 16 | 29 52 | 30 8 | 29087 | 17 | 70913 | 29932 | 17 | 70068 | 00845 | 1 | 99155 | 44 |
| 17 | 29 44 | 30 16 | 29150 | 18 | 70850 | 29998 | 18 | 70002 | 00848 | 1 | 99152 | 43 |
| 18 | 29 36 | 30 24 | 29214 | 19 | 70786 | 30064 | 19 | 69936 | 00850 | 1 | 99150 | 42 |
| 19 | 29 28 | 30 32 | 29277 | 20 | 70723 | 30130 | 20 | 69870 | 00853 | 1 | 99147 | 41 |
| 20 | 10 29 20 | 1 30 40 | 9. 29340 | 21 | 10. 70660 | 9. 30195 | 22 | 10. 69805 | 10. 00855 | 1 | 9. 99145 | 40 |
| 21 | 29 12 | 30 48 | 29403 | 22 | 70597 | 30261 | 23 | 69739 | 00858 | 1 | 99142 | 39 |
| 22 | 29 4 | 30 56 | 29466 | 23 | 70534 | 30326 | 24 | 69674 | 00860 | 1 | 99140 | 38 |
| 23 | 28 56 | 31 4 | 29529 | 24 | 70471 | 30391 | 25 | 69609 | 00863 | 1 | 99137 | 37 |
| 24 | 28 48 | 31 12 | 29591 | 25 | 70409 | 30457 | 26 | 69543 | 00865 | 1 | 99135 | 36 |
| 25 | 10 28 40 | 1 31 20 | 9. 29654 | 26 | 10. 70346 | 9. 30522 | 27 | 10. 69478 | 10. 00868 | 1 | 9. 99132 | 35 |
| 26 | 28 32 | 31 28 | 29716 | 27 | 70284 | 30587 | 28 | 69413 | 00870 | 1 | 99130 | 34 |
| 27 | 28 24 | 31 36 | 29779 | 28 | 70221 | 30652 | 29 | 69348 | 00873 | 1 | 99127 | 33 |
| 28 | 28 16 | 31 44 | 29841 | 29 | 70159 | 30717 | 30 | 69283 | 00876 | 1 | 99124 | 32 |
| 29 | 28 8 | 31 52 | 29903 | 30 | 70097 | 30782 | 31 | 69218 | 00878 | 1 | 99122 | 31 |
| 30 | 10 28 0 | 1 32 0 | 9. 29966 | 31 | 10. 70034 | 9. 30846 | 32 | 10. 69154 | 10. 00881 | 1 | 9. 99119 | 30 |
| 31 | 27 52 | 32 8 | 30028 | 32 | 69972 | 30911 | 33 | 69089 | 00883 | 1 | 99117 | 29 |
| 32 | 27 44 | 32 16 | 30090 | 33 | 69910 | 30975 | 35 | 69025 | 00886 | 1 | 99114 | 28 |
| 33 | 27 36 | 32 24 | 30151 | 34 | 69849 | 31040 | 36 | 68960 | 00888 | 1 | 99112 | 27 |
| 34 | 27 28 | 32 32 | 30213 | 35 | 69787 | 31104 | 37 | 68896 | 00891 | 1 | 99109 | 26 |
| 35 | 10 27 20 | 1 32 40 | 9. 30275 | 36 | 10. 69725 | 9. 31168 | 38 | 10. 68832 | 10. 00894 | 2 | 9. 99106 | 25 |
| 36 | 27 12 | 32 48 | 30336 | 37 | 69664 | 31233 | 39 | 68767 | 00896 | 2 | 99104 | 24 |
| 37 | 27 4 | 32 56 | 30398 | 38 | 69602 | 31297 | 40 | 68703 | 00899 | 2 | 99101 | 23 |
| 38 | 26 56 | 33 4 | 30459 | 39 | 69541 | 31361 | 41 | 68639 | 00901 | 2 | 99099 | 22 |
| 39 | 26 48 | 33 12 | 30521 | 40 | 69479 | 31425 | 42 | 68575 | 00904 | 2 | 99096 | 21 |
| 40 | 10 26 40 | 1 33 20 | 9. 30582 | 41 | 10. 69418 | 9. 31489 | 43 | 10. 68511 | 10. 00907 | 2 | 9. 99093 | 20 |
| 41 | 26 32 | 33 28 | 30643 | 42 | 69357 | 31552 | 44 | 68448 | 00909 | 2 | 99091 | 19 |
| 42 | 26 24 | 33 36 | 30704 | 43 | 69296 | 31616 | 45 | 68384 | 00912 | 2 | 99088 | 18 |
| 43 | 26 16 | 33 44 | 30765 | 45 | 69235 | 31679 | 46 | 68321 | 00914 | 2 | 99086 | 17 |
| 44 | 26 8 | 33 52 | 30826 | 46 | 69174 | 31743 | 47 | 68257 | 00917 | 2 | 99083 | 16 |
| 45 | 10 26 0 | 1 34 0 | 9. 30887 | 47 | 10. 69113 | 9. 31806 | 49 | 10. 68194 | 10. 00920 | 2 | 9. 99080 | 15 |
| 46 | 25 52 | 34 8 | 30947 | 48 | 69053 | 31870 | 50 | 68130 | 00922 | 2 | 99078 | 14 |
| 47 | 25 44 | 34 16 | 31008 | 49 | 68992 | 31933 | 51 | 68067 | 00925 | 2 | 99075 | 13 |
| 48 | 25 36 | 34 24 | 31068 | 50 | 68932 | 31996 | 52 | 68004 | 00928 | 2 | 99072 | 12 |
| 49 | 25 28 | 34 32 | 31129 | 51 | 68871 | 32059 | 53 | 67941 | 00930 | 2 | 99070 | 11 |
| 50 | 10 25 20 | 1 34 40 | 9. 31189 | 52 | 10. 68851 | 9. 32122 | 54 | 10. 67878 | 10. 00933 | 2 | 9. 99067 | 10 |
| 51 | 25 12 | 34 48 | 31250 | 53 | 68790 | 32185 | 55 | 67815 | 00936 | 2 | 99064 | 9 |
| 52 | 25 4 | 34 56 | 31310 | 54 | 68660 | 32248 | 56 | 67752 | 00938 | 2 | 99062 | 8 |
| 53 | 24 56 | 35 4 | 31370 | 55 | 68630 | 32311 | 57 | 67689 | 00941 | 2 | 99059 | 7 |
| 54 | 24 48 | 35 12 | 31430 | 56 | 68570 | 32373 | 58 | 67627 | 00944 | 2 | 99056 | 6 |
| 55 | 10 24 40 | 1 35 20 | 9. 31490 | 57 | 10. 68510 | 9. 32436 | 59 | 10. 67564 | 10. 00946 | 2 | 9. 99054 | 5 |
| 56 | 24 32 | 35 28 | 31549 | 58 | 68451 | 32498 | 60 | 67502 | 00949 | 2 | 99051 | 4 |
| 57 | 24 24 | 35 36 | 31609 | 59 | 68391 | 32561 | 61 | 67439 | 00952 | 2 | 99048 | 3 |
| 58 | 24 16 | 35 44 | 31669 | 60 | 68331 | 32623 | 63 | 67377 | 00954 | 2 | 99046 | 2 |
| 59 | 24 8 | 35 52 | 31728 | 61 | 68272 | 32685 | 64 | 67315 | 00957 | 3 | 99043 | 1 |
| 60 | 24 0 | 36 0 | 31788 | 62 | 68212 | 32747 | 65 | 67253 | 00960 | 3 | 99040 | 0 |

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SINES, TANGENTS, AND SECANTS

| 12° | | | | | | | | | | | | | 107° | |
|-----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|------|--|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | | |
| 0 | 10 24 0 | 1 36 0 | 9. 31788 | 0 | 10. 68212 | 9. 32474 | 0 | 10. 67253 | 10. 00960 | 0 | 9. 99040 | 60 | | |
| 1 | 23 52 | 36 8 | 31847 | 1 | 68153 | 32810 | 1 | 67190 | 00962 | 0 | 99038 | 59 | | |
| 2 | 23 44 | 36 16 | 31907 | 2 | 68093 | 32872 | 2 | 67128 | 00965 | 0 | 99035 | 58 | | |
| 3 | 23 36 | 36 24 | 31966 | 3 | 68034 | 32933 | 3 | 67067 | 00968 | 0 | 99032 | 57 | | |
| 4 | 23 28 | 36 32 | 32025 | 4 | 67975 | 32995 | 4 | 67005 | 00970 | 0 | 99030 | 56 | | |
| 5 | 10 23 20 | 1 36 40 | 9. 32084 | 5 | 10. 67916 | 9. 33057 | 5 | 10. 66943 | 10. 00973 | 0 | 9. 99027 | 55 | | |
| 6 | 23 12 | 36 48 | 32143 | 6 | 67857 | 33119 | 6 | 66881 | 00976 | 0 | 99024 | 54 | | |
| 7 | 23 4 | 36 56 | 32202 | 7 | 67798 | 33180 | 7 | 66820 | 00978 | 0 | 99022 | 53 | | |
| 8 | 22 56 | 37 4 | 32261 | 8 | 67739 | 33242 | 8 | 66758 | 00981 | 0 | 99019 | 52 | | |
| 9 | 22 48 | 37 12 | 32319 | 9 | 67681 | 33303 | 9 | 66697 | 00984 | 0 | 99016 | 51 | | |
| 10 | 10 22 40 | 1 37 20 | 9. 32378 | 10 | 10. 67622 | 9. 33365 | 10 | 10. 66635 | 10. 00987 | 0 | 9. 99013 | 50 | | |
| 11 | 22 32 | 37 28 | 32437 | 10 | 67563 | 33426 | 11 | 66574 | 00989 | 1 | 99011 | 49 | | |
| 12 | 22 24 | 37 36 | 32495 | 11 | 67505 | 33487 | 12 | 66513 | 00992 | 1 | 99008 | 48 | | |
| 13 | 22 16 | 37 44 | 32553 | 12 | 67447 | 33548 | 13 | 66452 | 00995 | 1 | 99005 | 47 | | |
| 14 | 22 8 | 37 52 | 32612 | 13 | 67388 | 33609 | 14 | 66391 | 00998 | 1 | 99002 | 46 | | |
| 15 | 10 22 0 | 1 38 0 | 9. 32670 | 14 | 10. 67330 | 9. 33670 | 15 | 10. 66330 | 10. 01000 | 1 | 9. 99000 | 45 | | |
| 16 | 21 52 | 38 8 | 32728 | 15 | 67272 | 33731 | 16 | 66269 | 01003 | 1 | 98997 | 44 | | |
| 17 | 21 44 | 38 16 | 32786 | 16 | 67214 | 33792 | 17 | 66208 | 01006 | 1 | 98994 | 43 | | |
| 18 | 21 36 | 38 24 | 32844 | 17 | 67156 | 33853 | 18 | 66147 | 01009 | 1 | 98991 | 42 | | |
| 19 | 21 28 | 38 32 | 32902 | 18 | 67098 | 33913 | 19 | 66087 | 01011 | 1 | 98989 | 41 | | |
| 20 | 10 21 20 | 1 38 40 | 9. 32960 | 19 | 10. 67040 | 9. 33974 | 20 | 10. 66026 | 10. 01014 | 1 | 9. 98986 | 40 | | |
| 21 | 21 12 | 38 48 | 33018 | 20 | 66982 | 34034 | 21 | 65966 | 01017 | 1 | 98983 | 39 | | |
| 22 | 21 4 | 38 56 | 33075 | 21 | 66925 | 34095 | 22 | 65905 | 01020 | 1 | 98980 | 38 | | |
| 23 | 20 56 | 39 4 | 33133 | 22 | 66867 | 34155 | 23 | 65845 | 01022 | 1 | 98978 | 37 | | |
| 24 | 20 48 | 39 12 | 33190 | 23 | 66810 | 34215 | 24 | 65785 | 01025 | 1 | 98975 | 36 | | |
| 25 | 10 20 40 | 1 39 20 | 9. 33248 | 24 | 10. 66752 | 9. 34276 | 25 | 10. 65724 | 10. 01028 | 1 | 9. 98972 | 35 | | |
| 26 | 20 32 | 39 28 | 33305 | 25 | 66695 | 34336 | 26 | 65664 | 01031 | 1 | 98969 | 34 | | |
| 27 | 20 24 | 39 36 | 33362 | 26 | 66638 | 34396 | 27 | 65604 | 01033 | 1 | 98967 | 33 | | |
| 28 | 20 16 | 39 44 | 33420 | 27 | 66580 | 34456 | 28 | 65544 | 01036 | 1 | 98964 | 32 | | |
| 29 | 20 8 | 39 52 | 33477 | 28 | 66523 | 34516 | 29 | 65484 | 01039 | 1 | 98961 | 31 | | |
| 30 | 10 20 0 | 1 40 0 | 9. 33534 | 29 | 10. 66466 | 9. 34576 | 30 | 10. 65421 | 10. 01042 | 1 | 9. 98958 | 30 | | |
| 31 | 19 52 | 40 8 | 33591 | 29 | 66409 | 34635 | 31 | 65365 | 01045 | 1 | 98955 | 29 | | |
| 32 | 19 44 | 40 16 | 33647 | 30 | 66353 | 34695 | 32 | 65305 | 01047 | 1 | 98953 | 28 | | |
| 33 | 19 36 | 40 24 | 33704 | 31 | 66296 | 34755 | 33 | 65245 | 01050 | 2 | 98950 | 27 | | |
| 34 | 19 28 | 40 32 | 33761 | 32 | 66239 | 34814 | 34 | 65186 | 01053 | 2 | 98947 | 26 | | |
| 35 | 10 19 20 | 1 40 40 | 9. 33818 | 33 | 10. 66182 | 9. 34874 | 35 | 10. 65126 | 10. 01056 | 2 | 9. 98944 | 25 | | |
| 36 | 19 12 | 40 48 | 33874 | 34 | 66126 | 34933 | 36 | 65067 | 01059 | 2 | 98941 | 24 | | |
| 37 | 19 4 | 40 56 | 33931 | 35 | 66069 | 34992 | 37 | 65008 | 01062 | 2 | 98938 | 23 | | |
| 38 | 18 56 | 41 4 | 33987 | 36 | 66013 | 35051 | 38 | 64949 | 01064 | 2 | 98936 | 22 | | |
| 39 | 18 48 | 41 12 | 34043 | 37 | 65957 | 35111 | 39 | 64889 | 01067 | 2 | 98933 | 21 | | |
| 40 | 10 18 40 | 1 41 20 | 9. 34100 | 38 | 10. 65900 | 9. 35170 | 40 | 10. 64830 | 10. 01070 | 2 | 9. 98930 | 20 | | |
| 41 | 18 32 | 41 28 | 34156 | 39 | 65844 | 35229 | 41 | 64771 | 01073 | 2 | 98927 | 19 | | |
| 42 | 18 24 | 41 36 | 34212 | 40 | 65788 | 35288 | 42 | 64712 | 01076 | 2 | 98924 | 18 | | |
| 43 | 18 16 | 41 44 | 34268 | 41 | 65732 | 35347 | 43 | 64653 | 01079 | 2 | 98921 | 17 | | |
| 44 | 18 8 | 41 52 | 34324 | 42 | 65676 | 35405 | 44 | 64595 | 01081 | 2 | 98919 | 16 | | |
| 45 | 10 18 0 | 1 42 0 | 9. 34380 | 43 | 10. 65620 | 9. 35464 | 45 | 10. 64536 | 10. 01084 | 2 | 9. 98916 | 15 | | |
| 46 | 17 52 | 42 8 | 34435 | 44 | 65564 | 35523 | 46 | 64477 | 01087 | 2 | 98913 | 14 | | |
| 47 | 17 44 | 42 16 | 34491 | 45 | 65509 | 35581 | 47 | 64419 | 01090 | 2 | 98910 | 13 | | |
| 48 | 17 36 | 42 24 | 34547 | 46 | 65453 | 35640 | 48 | 64360 | 01093 | 2 | 98907 | 12 | | |
| 49 | 17 28 | 42 32 | 34602 | 47 | 65398 | 35698 | 49 | 64302 | 01096 | 2 | 98904 | 11 | | |
| 50 | 10 17 20 | 1 42 40 | 9. 34658 | 48 | 10. 65342 | 9. 35757 | 50 | 10. 64243 | 10. 01099 | 2 | 9. 98901 | 10 | | |
| 51 | 17 12 | 42 48 | 34713 | 48 | 65287 | 35815 | 51 | 64185 | 01102 | 2 | 98898 | 9 | | |
| 52 | 17 4 | 42 56 | 34769 | 49 | 65231 | 35873 | 52 | 64127 | 01104 | 2 | 98896 | 8 | | |
| 53 | 16 56 | 43 4 | 34824 | 50 | 65176 | 35931 | 53 | 64069 | 01107 | 2 | 98893 | 7 | | |
| 54 | 16 48 | 43 12 | 34879 | 51 | 65121 | 35989 | 54 | 64011 | 01110 | 3 | 98890 | 6 | | |
| 55 | 10 16 40 | 1 43 20 | 9. 34934 | 52 | 10. 65066 | 9. 36047 | 55 | 10. 63953 | 10. 01113 | 3 | 9. 98887 | 5 | | |
| 56 | 16 32 | 43 28 | 34989 | 53 | 65011 | 36105 | 56 | 63895 | 01116 | 3 | 98884 | 4 | | |
| 57 | 16 24 | 43 36 | 35044 | 54 | 64956 | 36163 | 57 | 63837 | 01119 | 3 | 98881 | 3 | | |
| 58 | 16 16 | 43 44 | 35099 | 55 | 64901 | 36221 | 58 | 63779 | 01122 | 3 | 98878 | 2 | | |
| 59 | 16 8 | 43 52 | 35154 | 56 | 64846 | 36279 | 59 | 63721 | 01125 | 3 | 98875 | 1 | | |
| 60 | 16 0 | 44 0 | 35209 | 57 | 64791 | 36336 | 60 | 63664 | 01128 | 3 | 98872 | 0 | | |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. | | |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 10 16 0 | 1 44 0 | 9.35209 | 0 | 10.64791 | 9.36336 | 0 | 10.63664 | 10.01128 | 0 | 9.98872 | 60 |
| 1 | 15 52 | 44 8 | 35263 | 1 | 64737 | 36394 | 1 | 63606 | 01131 | 0 | 98869 | 59 |
| 2 | 15 44 | 44 16 | 35318 | 2 | 64682 | 36452 | 2 | 63548 | 01133 | 0 | 98867 | 58 |
| 3 | 15 36 | 44 24 | 35373 | 3 | 64627 | 36509 | 3 | 63491 | 01136 | 0 | 98864 | 57 |
| 4 | 15 28 | 44 32 | 35427 | 4 | 64573 | 36566 | 4 | 63434 | 01139 | 0 | 98861 | 56 |
| 5 | 10 15 20 | 1 44 40 | 9.35481 | 4 | 10.64519 | 9.36624 | 5 | 10.63376 | 10.01142 | 0 | 9.98858 | 55 |
| 6 | 15 12 | 44 48 | 35536 | 5 | 64464 | 36681 | 6 | 63319 | 01145 | 0 | 98855 | 54 |
| 7 | 15 4 | 44 56 | 35590 | 6 | 64410 | 36738 | 6 | 63262 | 01148 | 0 | 98852 | 53 |
| 8 | 14 56 | 45 4 | 35644 | 7 | 64356 | 36795 | 7 | 63205 | 01151 | 0 | 98849 | 52 |
| 9 | 14 48 | 45 12 | 35698 | 8 | 64302 | 36852 | 8 | 63148 | 01154 | 0 | 98846 | 51 |
| 10 | 10 14 40 | 1 45 20 | 9.35752 | 9 | 10.64248 | 9.36909 | 9 | 10.63091 | 10.01157 | 1 | 9.98843 | 50 |
| 11 | 14 32 | 45 28 | 35806 | 10 | 64194 | 36966 | 10 | 63034 | 01160 | 1 | 98840 | 49 |
| 12 | 14 24 | 45 36 | 35860 | 11 | 64140 | 37023 | 11 | 62977 | 01163 | 1 | 98837 | 48 |
| 13 | 14 16 | 45 44 | 35914 | 11 | 64086 | 37080 | 12 | 62920 | 01166 | 1 | 98834 | 47 |
| 14 | 14 8 | 45 52 | 35968 | 12 | 64032 | 37137 | 13 | 62863 | 01169 | 1 | 98831 | 46 |
| 15 | 10 14 0 | 1 46 0 | 9.36022 | 13 | 10.63978 | 9.37193 | 14 | 10.62807 | 10.01172 | 1 | 9.98828 | 45 |
| 16 | 13 52 | 46 8 | 36075 | 14 | 63925 | 37250 | 15 | 62750 | 01175 | 1 | 98825 | 44 |
| 17 | 13 44 | 46 16 | 36129 | 15 | 63871 | 37306 | 16 | 62694 | 01178 | 1 | 98822 | 43 |
| 18 | 13 36 | 46 24 | 36182 | 16 | 63818 | 37363 | 17 | 62637 | 01181 | 1 | 98819 | 42 |
| 19 | 13 28 | 46 32 | 36236 | 17 | 63764 | 37419 | 18 | 62581 | 01184 | 1 | 98816 | 41 |
| 20 | 10 13 20 | 1 46 40 | 9.36289 | 18 | 10.63711 | 9.37476 | 19 | 10.62524 | 10.01187 | 1 | 9.98813 | 40 |
| 21 | 13 12 | 46 48 | 36342 | 18 | 63658 | 37532 | 19 | 62468 | 01190 | 1 | 98810 | 39 |
| 22 | 13 4 | 46 56 | 36395 | 19 | 63605 | 37588 | 20 | 62412 | 01193 | 1 | 98807 | 38 |
| 23 | 12 56 | 47 4 | 36449 | 20 | 63551 | 37644 | 21 | 62356 | 01196 | 1 | 98804 | 37 |
| 24 | 12 48 | 47 12 | 36502 | 21 | 63498 | 37700 | 22 | 62300 | 01199 | 1 | 98801 | 36 |
| 25 | 10 12 40 | 1 47 20 | 9.36555 | 22 | 10.63445 | 9.37756 | 23 | 10.62244 | 10.01202 | 1 | 9.98798 | 35 |
| 26 | 12 32 | 47 28 | 36608 | 23 | 63392 | 37812 | 24 | 62188 | 01205 | 1 | 98795 | 34 |
| 27 | 12 24 | 47 36 | 36660 | 24 | 63340 | 37868 | 25 | 62132 | 01208 | 1 | 98792 | 33 |
| 28 | 12 16 | 47 44 | 36713 | 25 | 63287 | 37924 | 26 | 62076 | 01211 | 1 | 98789 | 32 |
| 29 | 12 8 | 47 52 | 36766 | 25 | 63234 | 37980 | 27 | 62020 | 01214 | 1 | 98786 | 31 |
| 30 | 10 12 0 | 1 48 0 | 9.36819 | 26 | 10.63181 | 9.38035 | 28 | 10.61965 | 10.01217 | 2 | 9.98783 | 30 |
| 31 | 11 52 | 48 8 | 36871 | 27 | 63129 | 38091 | 29 | 61909 | 01220 | 2 | 98780 | 29 |
| 32 | 11 44 | 48 16 | 36924 | 28 | 63076 | 38147 | 30 | 61853 | 01223 | 2 | 98777 | 28 |
| 33 | 11 36 | 48 24 | 36976 | 29 | 63024 | 38202 | 31 | 61798 | 01226 | 2 | 98774 | 27 |
| 34 | 11 28 | 48 32 | 37028 | 30 | 62972 | 38257 | 32 | 61743 | 01229 | 2 | 98771 | 26 |
| 35 | 10 11 20 | 1 48 40 | 9.37081 | 31 | 10.62919 | 9.38313 | 32 | 10.61687 | 10.01232 | 2 | 9.98768 | 25 |
| 36 | 11 12 | 48 48 | 37133 | 32 | 62867 | 38368 | 33 | 61632 | 01235 | 2 | 98765 | 24 |
| 37 | 11 4 | 48 56 | 37185 | 33 | 62815 | 38423 | 34 | 61577 | 01238 | 2 | 98762 | 23 |
| 38 | 10 56 | 49 4 | 37237 | 33 | 62763 | 38479 | 35 | 61521 | 01241 | 2 | 98759 | 22 |
| 39 | 10 48 | 49 12 | 37289 | 34 | 62711 | 38534 | 36 | 61466 | 01244 | 2 | 98756 | 21 |
| 40 | 10 10 40 | 1 49 20 | 9.37341 | 35 | 10.62659 | 9.38589 | 37 | 10.61411 | 10.01247 | 2 | 9.98753 | 20 |
| 41 | 10 32 | 49 28 | 37393 | 36 | 62607 | 38644 | 38 | 61356 | 01250 | 2 | 98750 | 19 |
| 42 | 10 24 | 49 36 | 37445 | 37 | 62555 | 38699 | 39 | 61301 | 01254 | 2 | 98746 | 18 |
| 43 | 10 16 | 49 44 | 37497 | 38 | 62503 | 38754 | 40 | 61246 | 01257 | 2 | 98743 | 17 |
| 44 | 10 8 | 49 52 | 37549 | 39 | 62451 | 38808 | 41 | 61192 | 01260 | 2 | 98740 | 16 |
| 45 | 10 10 0 | 1 50 0 | 9.37600 | 39 | 10.62400 | 9.38863 | 42 | 10.61137 | 10.01263 | 2 | 9.98737 | 15 |
| 46 | 9 52 | 50 8 | 37652 | 40 | 62348 | 38918 | 43 | 61082 | 01266 | 2 | 98734 | 14 |
| 47 | 9 44 | 50 16 | 37703 | 41 | 62297 | 38972 | 44 | 61028 | 01269 | 2 | 98731 | 13 |
| 48 | 9 36 | 50 24 | 37755 | 42 | 62245 | 39027 | 45 | 60973 | 01272 | 2 | 98728 | 12 |
| 49 | 9 28 | 50 32 | 37806 | 43 | 62194 | 39082 | 45 | 60918 | 01275 | 2 | 98725 | 11 |
| 50 | 10 9 20 | 1 50 40 | 9.37858 | 44 | 10.62142 | 9.39136 | 46 | 10.60864 | 10.01278 | 3 | 9.98722 | 10 |
| 51 | 9 12 | 50 48 | 37909 | 45 | 62091 | 39190 | 47 | 60810 | 01281 | 3 | 98719 | 9 |
| 52 | 9 4 | 50 56 | 37960 | 46 | 62040 | 39245 | 48 | 60755 | 01285 | 3 | 98715 | 8 |
| 53 | 8 56 | 51 4 | 38011 | 47 | 61989 | 39299 | 49 | 60701 | 01288 | 3 | 98712 | 7 |
| 54 | 8 48 | 51 12 | 38062 | 47 | 61938 | 39353 | 50 | 60647 | 01291 | 3 | 98709 | 6 |
| 55 | 10 8 40 | 1 51 20 | 9.38113 | 48 | 10.61887 | 9.39407 | 51 | 10.60593 | 10.01294 | 3 | 9.98706 | 5 |
| 56 | 8 32 | 51 28 | 38164 | 49 | 61836 | 39461 | 52 | 60539 | 01297 | 3 | 98703 | 4 |
| 57 | 8 24 | 51 36 | 38215 | 50 | 61785 | 39515 | 53 | 60485 | 01300 | 3 | 98700 | 3 |
| 58 | 8 16 | 51 44 | 38266 | 51 | 61734 | 39569 | 54 | 60431 | 01303 | 3 | 98697 | 2 |
| 59 | 8 8 | 51 52 | 38317 | 52 | 61683 | 39623 | 55 | 60377 | 01306 | 3 | 98694 | 1 |
| 60 | 8 0 | 52 0 | 38368 | 53 | 61632 | 39677 | 56 | 60323 | 01310 | 3 | 98690 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 10 8 0 | 1 52 0 | 9. 38368 | 0 | 10. 61632 | 9. 39677 | 0 | 10. 60323 | 10. 01310 | 0 | 9. 98690 | 60 |
| 1 | 7 52 | 52 8 | 38418 | 1 | 61582 | 39731 | 1 | 60269 | 01313 | 0 | 98687 | 59 |
| 2 | 7 44 | 52 16 | 38469 | 2 | 61531 | 39785 | 2 | 60215 | 01316 | 0 | 98684 | 58 |
| 3 | 7 36 | 52 24 | 38519 | 2 | 61481 | 39838 | 3 | 60162 | 01319 | 0 | 98681 | 57 |
| 4 | 7 28 | 52 32 | 38570 | 3 | 61430 | 39892 | 3 | 60108 | 01322 | 0 | 98678 | 56 |
| 5 | 10 7 20 | 1 52 40 | 9. 38620 | 4 | 10. 61380 | 9. 39945 | 4 | 10. 60055 | 10. 01325 | 0 | 9. 98675 | 55 |
| 6 | 7 12 | 52 48 | 38670 | 5 | 61330 | 39999 | 5 | 60001 | 01329 | 0 | 98671 | 54 |
| 7 | 7 4 | 52 56 | 38721 | 6 | 61279 | 40053 | 6 | 59948 | 01332 | 0 | 98668 | 53 |
| 8 | 6 56 | 53 4 | 38771 | 7 | 61229 | 40106 | 7 | 59894 | 01335 | 0 | 98665 | 52 |
| 9 | 6 48 | 53 12 | 38821 | 7 | 61179 | 40159 | 8 | 59841 | 01338 | 0 | 98662 | 51 |
| 10 | 10 6 40 | 1 53 20 | 9. 38871 | 8 | 10. 61129 | 9. 40212 | 9 | 10. 59788 | 10. 01341 | 1 | 9. 98659 | 50 |
| 11 | 6 32 | 53 28 | 38921 | 9 | 61079 | 40266 | 10 | 59734 | 01344 | 1 | 98656 | 49 |
| 12 | 6 24 | 53 36 | 38971 | 10 | 61029 | 40319 | 10 | 59681 | 01348 | 1 | 98653 | 48 |
| 13 | 6 16 | 53 44 | 39021 | 11 | 60979 | 40372 | 11 | 59628 | 01351 | 1 | 98649 | 47 |
| 14 | 6 8 | 53 52 | 39071 | 11 | 60929 | 40425 | 12 | 59575 | 01354 | 1 | 98646 | 46 |
| 15 | 10 5 6 | 1 54 0 | 9. 39121 | 12 | 10. 60879 | 9. 40478 | 13 | 10. 59522 | 10. 01357 | 1 | 9. 98643 | 45 |
| 16 | 5 52 | 54 8 | 39170 | 13 | 60830 | 40531 | 14 | 59469 | 01360 | 1 | 98640 | 44 |
| 17 | 5 44 | 54 16 | 39220 | 14 | 60780 | 40584 | 15 | 59416 | 01364 | 1 | 98636 | 43 |
| 18 | 5 36 | 54 24 | 39270 | 15 | 60730 | 40636 | 16 | 59364 | 01367 | 1 | 98633 | 42 |
| 19 | 5 28 | 54 32 | 39319 | 15 | 60681 | 40689 | 17 | 59311 | 01370 | 1 | 98630 | 41 |
| 20 | 10 5 20 | 1 54 40 | 9. 39369 | 16 | 10. 60631 | 9. 40742 | 17 | 10. 59258 | 10. 01373 | 1 | 9. 98627 | 40 |
| 21 | 5 12 | 54 48 | 39418 | 17 | 60582 | 40795 | 18 | 59205 | 01377 | 1 | 98623 | 39 |
| 22 | 5 4 | 54 56 | 39467 | 18 | 60533 | 40847 | 19 | 59153 | 01380 | 1 | 98620 | 38 |
| 23 | 4 56 | 55 4 | 39517 | 19 | 60483 | 40900 | 20 | 59100 | 01383 | 1 | 98617 | 37 |
| 24 | 4 48 | 55 12 | 39566 | 20 | 60434 | 40952 | 21 | 59048 | 01386 | 1 | 98614 | 36 |
| 25 | 10 4 40 | 1 55 20 | 9. 39615 | 20 | 10. 60385 | 9. 41005 | 22 | 10. 58995 | 10. 01390 | 1 | 9. 98610 | 35 |
| 26 | 4 32 | 55 28 | 39664 | 21 | 60336 | 41057 | 23 | 58943 | 01393 | 1 | 98607 | 34 |
| 27 | 4 24 | 55 36 | 39713 | 22 | 60287 | 41109 | 23 | 58891 | 01396 | 1 | 98604 | 33 |
| 28 | 4 16 | 55 44 | 39762 | 23 | 60238 | 41161 | 24 | 58839 | 01399 | 2 | 98601 | 32 |
| 29 | 4 8 | 55 52 | 39811 | 24 | 60189 | 41214 | 25 | 58786 | 01403 | 2 | 98597 | 31 |
| 30 | 10 4 0 | 1 56 0 | 9. 39860 | 24 | 10. 60140 | 9. 41266 | 26 | 10. 58734 | 10. 01406 | 2 | 9. 98594 | 30 |
| 31 | 3 52 | 56 8 | 39909 | 25 | 60091 | 41318 | 27 | 58682 | 01409 | 2 | 98591 | 29 |
| 32 | 3 44 | 56 16 | 39958 | 26 | 60042 | 41370 | 28 | 58630 | 01412 | 2 | 98588 | 28 |
| 33 | 3 36 | 56 24 | 40006 | 27 | 59994 | 41422 | 29 | 58578 | 01416 | 2 | 98584 | 27 |
| 34 | 3 28 | 56 32 | 40055 | 28 | 59945 | 41474 | 30 | 58526 | 01419 | 2 | 98581 | 26 |
| 35 | 10 3 20 | 1 56 40 | 9. 40103 | 29 | 10. 59897 | 9. 41526 | 30 | 10. 58474 | 10. 01422 | 2 | 9. 98578 | 25 |
| 36 | 3 12 | 56 48 | 40152 | 29 | 59848 | 41578 | 31 | 58422 | 01426 | 2 | 98574 | 24 |
| 37 | 3 4 | 56 56 | 40200 | 30 | 59800 | 41629 | 32 | 58371 | 01429 | 2 | 98571 | 23 |
| 38 | 2 56 | 57 4 | 40249 | 31 | 59751 | 41681 | 33 | 58319 | 01432 | 2 | 98568 | 22 |
| 39 | 2 48 | 57 12 | 40297 | 32 | 59703 | 41733 | 34 | 58267 | 01435 | 2 | 98565 | 21 |
| 40 | 10 2 40 | 1 57 20 | 9. 40346 | 33 | 10. 59654 | 9. 41784 | 35 | 10. 58216 | 10. 01439 | 2 | 9. 98561 | 20 |
| 41 | 2 32 | 57 28 | 40394 | 33 | 59606 | 41836 | 36 | 58164 | 01442 | 2 | 98558 | 19 |
| 42 | 2 24 | 57 36 | 40442 | 34 | 59558 | 41887 | 36 | 58113 | 01445 | 2 | 98555 | 18 |
| 43 | 2 16 | 57 44 | 40490 | 35 | 59510 | 41939 | 37 | 58061 | 01449 | 2 | 98551 | 17 |
| 44 | 2 8 | 57 52 | 40538 | 36 | 59462 | 41990 | 38 | 58010 | 01452 | 2 | 98548 | 16 |
| 45 | 10 2 0 | 1 58 0 | 9. 40586 | 37 | 10. 59414 | 9. 42041 | 39 | 10. 57959 | 10. 01455 | 2 | 9. 98545 | 15 |
| 46 | 1 52 | 58 8 | 40634 | 37 | 59366 | 42093 | 40 | 57907 | 01459 | 3 | 98541 | 14 |
| 47 | 1 44 | 58 16 | 40682 | 38 | 59318 | 42144 | 41 | 57856 | 01462 | 3 | 98538 | 13 |
| 48 | 1 36 | 58 24 | 40730 | 39 | 59270 | 42195 | 42 | 57805 | 01465 | 3 | 98535 | 12 |
| 49 | 1 28 | 58 32 | 40778 | 40 | 59222 | 42246 | 43 | 57754 | 01469 | 3 | 98531 | 11 |
| 50 | 10 1 20 | 1 58 40 | 9. 40825 | 41 | 10. 59175 | 9. 42297 | 43 | 10. 57703 | 10. 01472 | 3 | 9. 98528 | 10 |
| 51 | 1 12 | 58 48 | 40873 | 42 | 59127 | 42348 | 44 | 57652 | 01475 | 3 | 98525 | 9 |
| 52 | 1 4 | 58 56 | 40921 | 42 | 59079 | 42399 | 45 | 57601 | 01479 | 3 | 98521 | 8 |
| 53 | 0 56 | 59 4 | 40968 | 43 | 59032 | 42450 | 46 | 57550 | 01482 | 3 | 98518 | 7 |
| 54 | 0 48 | 59 12 | 41016 | 44 | 58984 | 42501 | 47 | 57499 | 01485 | 3 | 98515 | 6 |
| 55 | 10 0 40 | 1 59 20 | 9. 41063 | 45 | 10. 58937 | 9. 42552 | 48 | 10. 57448 | 10. 01489 | 3 | 9. 98511 | 5 |
| 56 | 0 32 | 59 28 | 41111 | 46 | 58889 | 42603 | 49 | 57397 | 01492 | 3 | 98508 | 4 |
| 57 | 0 24 | 59 36 | 41158 | 46 | 58842 | 42653 | 50 | 57347 | 01495 | 3 | 98505 | 3 |
| 58 | 0 16 | 59 44 | 41205 | 47 | 58795 | 42704 | 50 | 57296 | 01499 | 3 | 98501 | 2 |
| 59 | 0 8 | 59 52 | 41252 | 48 | 58748 | 42755 | 51 | 57245 | 01502 | 3 | 98498 | 1 |
| 60 | 0 0 | 2 0 0 | 41300 | 49 | 58700 | 42805 | 52 | 57195 | 01506 | 3 | 98494 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|----------|-------|------------|-----------|-------|----------|----|
| 0 | 10 0 0 | 2 0 0 | 9. 41300 | 0 | 10. 58700 | 9. 42805 | 0 | 10. 57195 | 10. 01506 | 0 | 9. 98494 | 60 |
| 1 | 9 59 52 | 0 8 | 41347 | 1 | 58653 | 42856 | 1 | 57144 | 01509 | 0 | 98491 | 59 |
| 2 | 59 44 | 0 16 | 41394 | 2 | 58606 | 42906 | 2 | 57094 | 01512 | 0 | 98488 | 58 |
| 3 | 59 36 | 0 24 | 41441 | 2 | 58559 | 42957 | 2 | 57043 | 01516 | 0 | 98484 | 57 |
| 4 | 59 28 | 0 32 | 41488 | 3 | 58512 | 43007 | 3 | 56993 | 01519 | 0 | 98481 | 56 |
| 5 | 9 59 20 | 2 0 40 | 9. 41535 | 4 | 10. 58465 | 9. 43057 | 4 | 10. 56943 | 10. 01523 | 0 | 9. 98477 | 55 |
| 6 | 59 12 | 0 48 | 41582 | 5 | 58418 | 43108 | 5 | 56892 | 01526 | 0 | 98474 | 54 |
| 7 | 59 4 | 0 56 | 41628 | 5 | 58372 | 43158 | 6 | 56842 | 01529 | 0 | 98471 | 53 |
| 8 | 58 56 | 1 4 | 41675 | 6 | 58325 | 43208 | 7 | 56792 | 01533 | 0 | 98467 | 52 |
| 9 | 58 48 | 1 12 | 41722 | 7 | 58278 | 43258 | 7 | 56742 | 01536 | 1 | 98464 | 51 |
| 10 | 9 58 40 | 2 1 20 | 9. 41768 | 8 | 10. 58232 | 9. 43308 | 8 | 10. 56692 | 10. 01540 | 1 | 9. 98460 | 50 |
| 11 | 58 32 | 1 28 | 41815 | 8 | 58185 | 43358 | 9 | 56642 | 01543 | 1 | 98457 | 49 |
| 12 | 58 24 | 1 36 | 41861 | 9 | 58139 | 43408 | 10 | 56592 | 01547 | 1 | 98453 | 48 |
| 13 | 58 16 | 1 44 | 41908 | 10 | 58092 | 43458 | 11 | 56542 | 01550 | 1 | 98450 | 47 |
| 14 | 58 8 | 1 52 | 41954 | 11 | 58046 | 43508 | 11 | 56492 | 01553 | 1 | 98447 | 46 |
| 15 | 9 58 0 | 2 2 0 | 9. 42001 | 11 | 10. 57999 | 9. 43558 | 12 | 10. 56442 | 10. 01557 | 1 | 9. 98443 | 45 |
| 16 | 57 52 | 2 8 | 42047 | 12 | 57953 | 43607 | 13 | 56393 | 01560 | 1 | 98440 | 44 |
| 17 | 57 44 | 2 16 | 42093 | 13 | 57907 | 43657 | 14 | 56343 | 01564 | 1 | 98436 | 43 |
| 18 | 57 36 | 2 24 | 42140 | 14 | 57860 | 43707 | 15 | 56293 | 01567 | 1 | 98433 | 42 |
| 19 | 57 28 | 2 32 | 42186 | 14 | 57814 | 43756 | 16 | 56244 | 01571 | 1 | 98429 | 41 |
| 20 | 9 57 20 | 2 2 40 | 9. 42232 | 15 | 10. 57768 | 9. 43806 | 16 | 10. 56194 | 10. 01574 | 1 | 9. 98426 | 40 |
| 21 | 57 12 | 2 48 | 42278 | 16 | 57722 | 43855 | 17 | 56145 | 01578 | 1 | 98422 | 39 |
| 22 | 57 4 | 2 56 | 42324 | 17 | 57676 | 43905 | 18 | 56095 | 01581 | 1 | 98419 | 38 |
| 23 | 56 56 | 3 4 | 42370 | 17 | 57630 | 43954 | 19 | 56046 | 01585 | 1 | 98415 | 37 |
| 24 | 56 48 | 3 12 | 42416 | 18 | 57584 | 44004 | 20 | 55996 | 01588 | 1 | 98412 | 36 |
| 25 | 9 56 40 | 2 3 20 | 9. 42461 | 19 | 10. 57539 | 9. 44053 | 20 | 10. 55947 | 10. 01591 | 1 | 9. 98409 | 35 |
| 26 | 56 32 | 3 28 | 42507 | 20 | 57493 | 44102 | 21 | 55898 | 01595 | 2 | 98405 | 34 |
| 27 | 56 24 | 3 36 | 42553 | 21 | 57447 | 44151 | 22 | 55849 | 01598 | 2 | 98402 | 33 |
| 28 | 56 16 | 3 44 | 42599 | 21 | 57401 | 44201 | 23 | 55799 | 01602 | 2 | 98398 | 32 |
| 29 | 56 8 | 3 52 | 42644 | 22 | 57356 | 44250 | 24 | 55750 | 01605 | 2 | 98395 | 31 |
| 30 | 9 56 0 | 2 4 0 | 9. 42690 | 23 | 10. 57310 | 9. 44299 | 25 | 10. 55701 | 10. 01609 | 2 | 9. 98391 | 30 |
| 31 | 55 52 | 4 8 | 42735 | 24 | 57265 | 44348 | 25 | 55652 | 01612 | 2 | 98388 | 29 |
| 32 | 55 44 | 4 16 | 42781 | 24 | 57219 | 44397 | 26 | 55603 | 01616 | 2 | 98384 | 28 |
| 33 | 55 36 | 4 24 | 42826 | 25 | 57174 | 44446 | 27 | 55554 | 01619 | 2 | 98381 | 27 |
| 34 | 55 28 | 4 32 | 42872 | 26 | 57128 | 44495 | 28 | 55505 | 01623 | 2 | 98377 | 26 |
| 35 | 9 55 20 | 2 4 40 | 9. 42917 | 27 | 10. 57083 | 9. 44544 | 29 | 10. 55456 | 10. 01627 | 2 | 9. 98373 | 25 |
| 36 | 55 12 | 4 48 | 42962 | 27 | 57038 | 44592 | 29 | 55408 | 01630 | 2 | 98370 | 24 |
| 37 | 55 4 | 4 56 | 43008 | 28 | 56992 | 44641 | 30 | 55359 | 01634 | 2 | 98366 | 23 |
| 38 | 54 56 | 5 4 | 43053 | 29 | 56947 | 44690 | 31 | 55310 | 01637 | 2 | 98363 | 22 |
| 39 | 54 48 | 5 12 | 43098 | 30 | 56902 | 44738 | 32 | 55262 | 01641 | 2 | 98359 | 21 |
| 40 | 9 54 40 | 2 5 20 | 9. 43143 | 30 | 10. 56857 | 9. 44787 | 33 | 10. 55213 | 10. 01644 | 2 | 9. 98356 | 20 |
| 41 | 54 32 | 5 28 | 43188 | 31 | 56812 | 44836 | 34 | 55164 | 01648 | 2 | 98352 | 19 |
| 42 | 54 24 | 5 36 | 43233 | 32 | 56767 | 44884 | 34 | 55116 | 01651 | 2 | 98349 | 18 |
| 43 | 54 16 | 5 44 | 43278 | 33 | 56722 | 44933 | 35 | 55067 | 01655 | 3 | 98345 | 17 |
| 44 | 54 8 | 5 52 | 43323 | 33 | 56677 | 44981 | 36 | 55019 | 01658 | 3 | 98342 | 16 |
| 45 | 9 54 0 | 2 6 0 | 9. 43367 | 34 | 10. 56633 | 9. 45029 | 37 | 10. 54971 | 10. 01662 | 3 | 9. 98338 | 15 |
| 46 | 53 52 | 6 8 | 43412 | 35 | 56588 | 45078 | 38 | 54922 | 01666 | 3 | 98334 | 14 |
| 47 | 53 44 | 6 16 | 43457 | 36 | 56543 | 45126 | 38 | 54874 | 01669 | 3 | 98331 | 13 |
| 48 | 53 36 | 6 24 | 43502 | 36 | 56498 | 45174 | 39 | 54826 | 01673 | 3 | 98327 | 12 |
| 49 | 53 28 | 6 32 | 43546 | 37 | 56454 | 45222 | 40 | 54778 | 01676 | 3 | 98324 | 11 |
| 50 | 9 53 20 | 2 6 40 | 9. 43591 | 38 | 10. 56409 | 9. 45271 | 41 | 10. 54729 | 10. 01680 | 3 | 9. 98320 | 10 |
| 51 | 53 12 | 6 48 | 43635 | 39 | 56365 | 45319 | 42 | 54681 | 01683 | 3 | 98317 | 9 |
| 52 | 53 4 | 6 56 | 43680 | 39 | 56320 | 45367 | 43 | 54633 | 01687 | 3 | 98313 | 8 |
| 53 | 52 56 | 7 4 | 43724 | 40 | 56276 | 45415 | 43 | 54585 | 01691 | 3 | 98309 | 7 |
| 54 | 52 48 | 7 12 | 43769 | 41 | 56231 | 45463 | 44 | 54537 | 01694 | 3 | 98306 | 6 |
| 55 | 9 52 40 | 2 7 20 | 9. 43813 | 42 | 10. 56187 | 9. 45511 | 45 | 10. 54489 | 10. 01698 | 3 | 9. 98302 | 5 |
| 56 | 52 32 | 7 28 | 43857 | 43 | 56143 | 45559 | 46 | 54441 | 01701 | 3 | 98299 | 4 |
| 57 | 52 24 | 7 36 | 43901 | 43 | 56099 | 45606 | 47 | 54394 | 01705 | 3 | 98295 | 3 |
| 58 | 52 16 | 7 44 | 43946 | 44 | 56054 | 45654 | 47 | 54346 | 01709 | 3 | 98291 | 2 |
| 59 | 52 8 | 7 52 | 43990 | 45 | 56010 | 45702 | 48 | 54298 | 01712 | 3 | 98288 | 1 |
| 60 | 52 0 | 8 0 | 44034 | 46 | 55966 | 45750 | 49 | 54250 | 01716 | 4 | 98284 | 0 |

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|

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74°

SINES, TANGENTS, AND SECANTS.

16°

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|----------|-------|------------|-----------|-------|----------|----|
| 0 | 9 52 0 | 2 8 0 | 9. 44034 | 0 | 10. 55966 | 9. 45750 | 0 | 10. 54250 | 10. 01716 | 0 | 9. 98284 | 60 |
| 1 | 51 52 | 8 8 | 44078 | 1 | 55922 | 45797 | 1 | 54203 | 01719 | 0 | 98281 | 59 |
| 2 | 51 44 | 8 16 | 44122 | 1 | 55878 | 45845 | 2 | 54155 | 01723 | 0 | 98277 | 58 |
| 3 | 51 36 | 8 24 | 44166 | 2 | 55834 | 45892 | 2 | 54108 | 01727 | 0 | 98273 | 57 |
| 4 | 51 28 | 8 32 | 44210 | 3 | 55790 | 45940 | 3 | 54060 | 01730 | 0 | 98270 | 56 |
| 5 | 9 51 20 | 2 8 40 | 9. 44253 | 4 | 10. 55747 | 9. 45987 | 4 | 10. 54013 | 10. 01734 | 0 | 9. 98266 | 55 |
| 6 | 51 12 | 8 48 | 44297 | 4 | 55703 | 46035 | 5 | 53965 | 01738 | 0 | 98262 | 54 |
| 7 | 51 4 | 8 56 | 44341 | 5 | 55659 | 46082 | 5 | 53918 | 01741 | 0 | 98259 | 53 |
| 8 | 50 56 | 9 4 | 44385 | 6 | 55615 | 46130 | 6 | 53870 | 01745 | 0 | 98255 | 52 |
| 9 | 50 48 | 9 12 | 44428 | 6 | 55572 | 46177 | 7 | 53823 | 01749 | 1 | 98251 | 51 |
| 10 | 9 50 40 | 2 9 20 | 9. 44472 | 7 | 10. 55528 | 9. 46224 | 8 | 10. 53776 | 10. 01752 | 1 | 9. 98248 | 50 |
| 11 | 50 32 | 9 28 | 44516 | 8 | 55484 | 46271 | 9 | 53729 | 01756 | 1 | 98244 | 49 |
| 12 | 50 24 | 9 36 | 44559 | 9 | 55441 | 46319 | 9 | 53681 | 01760 | 1 | 98240 | 48 |
| 13 | 50 16 | 9 44 | 44602 | 9 | 55398 | 46366 | 10 | 53634 | 01763 | 1 | 98237 | 47 |
| 14 | 50 8 | 9 52 | 44646 | 10 | 55354 | 46413 | 11 | 53587 | 01767 | 1 | 98233 | 46 |
| 15 | 9 50 0 | 2 10 0 | 9. 44689 | 11 | 10. 55311 | 9. 46460 | 12 | 10. 53540 | 10. 01771 | 1 | 9. 98229 | 45 |
| 16 | 49 52 | 10 8 | 44733 | 11 | 55267 | 46507 | 12 | 53493 | 01774 | 1 | 98226 | 44 |
| 17 | 49 44 | 10 16 | 44776 | 12 | 55224 | 46554 | 13 | 53446 | 01778 | 1 | 98222 | 43 |
| 18 | 49 36 | 10 24 | 44819 | 13 | 55181 | 46601 | 14 | 53399 | 01782 | 1 | 98218 | 42 |
| 19 | 49 28 | 10 32 | 44862 | 14 | 55138 | 46648 | 15 | 53352 | 01785 | 1 | 98215 | 41 |
| 20 | 9 49 20 | 2 10 40 | 9. 44905 | 14 | 55095 | 9. 46694 | 15 | 10. 53306 | 10. 01789 | 1 | 9. 98211 | 40 |
| 21 | 49 12 | 10 48 | 44948 | 15 | 55052 | 46741 | 16 | 53259 | 01793 | 1 | 98207 | 39 |
| 22 | 49 4 | 10 56 | 44992 | 16 | 55008 | 46788 | 17 | 53212 | 01796 | 1 | 98204 | 38 |
| 23 | 48 56 | 11 4 | 45035 | 16 | 54965 | 46835 | 18 | 53165 | 01800 | 1 | 98200 | 37 |
| 24 | 48 48 | 11 12 | 45077 | 17 | 54923 | 46881 | 19 | 53119 | 01804 | 1 | 98196 | 36 |
| 25 | 9 48 0 | 2 11 20 | 9. 45120 | 18 | 10. 54880 | 9. 46928 | 19 | 10. 53072 | 10. 01808 | 2 | 9. 98192 | 35 |
| 26 | 48 32 | 11 28 | 45163 | 18 | 54837 | 46975 | 20 | 53025 | 01811 | 2 | 98189 | 34 |
| 27 | 48 24 | 11 36 | 45206 | 19 | 54794 | 47021 | 21 | 52979 | 01815 | 2 | 98185 | 33 |
| 28 | 48 16 | 11 44 | 45249 | 20 | 54751 | 47068 | 22 | 52932 | 01819 | 2 | 98181 | 32 |
| 29 | 48 8 | 11 52 | 45292 | 21 | 54708 | 47114 | 22 | 52886 | 01823 | 2 | 98177 | 31 |
| 30 | 9 48 0 | 2 12 0 | 9. 45334 | 21 | 10. 54666 | 9. 47160 | 23 | 10. 52840 | 10. 01826 | 2 | 9. 98174 | 30 |
| 31 | 47 52 | 12 8 | 45377 | 22 | 54623 | 47207 | 24 | 52793 | 01830 | 2 | 98170 | 29 |
| 32 | 47 44 | 12 16 | 45419 | 23 | 54581 | 47253 | 25 | 52747 | 01834 | 2 | 98166 | 28 |
| 33 | 47 36 | 12 24 | 45462 | 23 | 54538 | 47299 | 26 | 52701 | 01838 | 2 | 98162 | 27 |
| 34 | 47 28 | 12 32 | 45504 | 24 | 54496 | 47346 | 26 | 52654 | 01841 | 2 | 98159 | 26 |
| 35 | 9 47 20 | 2 12 40 | 9. 45547 | 25 | 10. 54453 | 9. 47392 | 27 | 10. 52608 | 10. 01845 | 2 | 9. 98155 | 25 |
| 36 | 47 12 | 12 48 | 45589 | 26 | 54411 | 47438 | 28 | 52562 | 01849 | 2 | 98151 | 24 |
| 37 | 47 4 | 12 56 | 45632 | 26 | 54368 | 47484 | 29 | 52516 | 01853 | 2 | 98147 | 23 |
| 38 | 46 56 | 13 4 | 45674 | 27 | 54326 | 47530 | 29 | 52470 | 01856 | 2 | 98144 | 22 |
| 39 | 46 48 | 13 12 | 45716 | 28 | 54284 | 47576 | 30 | 52424 | 01860 | 2 | 98140 | 21 |
| 40 | 9 46 40 | 2 13 20 | 9. 45758 | 28 | 10. 54242 | 9. 47622 | 31 | 10. 52378 | 10. 01864 | 2 | 9. 98136 | 20 |
| 41 | 46 32 | 13 28 | 45801 | 29 | 54199 | 47668 | 32 | 52332 | 01868 | 3 | 98132 | 19 |
| 42 | 46 24 | 13 36 | 45843 | 30 | 54157 | 47714 | 32 | 52286 | 01871 | 3 | 98129 | 18 |
| 43 | 46 16 | 13 44 | 45885 | 31 | 54115 | 47760 | 33 | 52240 | 01875 | 3 | 98125 | 17 |
| 44 | 46 8 | 13 52 | 45927 | 31 | 54073 | 47806 | 34 | 52194 | 01879 | 3 | 98121 | 16 |
| 45 | 9 46 0 | 2 14 0 | 9. 45969 | 32 | 10. 54031 | 9. 47852 | 35 | 10. 52148 | 10. 01883 | 3 | 9. 98117 | 15 |
| 46 | 45 52 | 14 8 | 46011 | 33 | 53989 | 47897 | 36 | 52103 | 01887 | 3 | 98113 | 14 |
| 47 | 45 44 | 14 16 | 46053 | 33 | 53947 | 47943 | 36 | 52057 | 01890 | 3 | 98110 | 13 |
| 48 | 45 36 | 14 24 | 46095 | 34 | 53905 | 47989 | 37 | 52011 | 01894 | 3 | 98106 | 12 |
| 49 | 45 28 | 14 32 | 46136 | 35 | 53864 | 48035 | 38 | 51965 | 01898 | 3 | 98102 | 11 |
| 50 | 9 45 20 | 2 14 40 | 9. 46178 | 36 | 10. 53822 | 9. 48080 | 39 | 10. 51920 | 10. 01902 | 3 | 9. 98098 | 10 |
| 51 | 45 12 | 14 48 | 46220 | 36 | 53780 | 48126 | 39 | 51874 | 01906 | 3 | 98094 | 9 |
| 52 | 45 4 | 14 56 | 46262 | 37 | 53738 | 48171 | 40 | 51829 | 01910 | 3 | 98090 | 8 |
| 53 | 44 56 | 15 4 | 46303 | 38 | 53697 | 48217 | 41 | 51783 | 01913 | 3 | 98087 | 7 |
| 54 | 44 48 | 15 12 | 46345 | 38 | 53655 | 48262 | 42 | 51738 | 01917 | 3 | 98083 | 6 |
| 55 | 9 44 40 | 2 15 20 | 9. 46386 | 39 | 10. 53614 | 9. 48307 | 43 | 10. 51693 | 10. 01921 | 3 | 9. 98079 | 5 |
| 56 | 44 32 | 15 28 | 46428 | 40 | 53572 | 48353 | 43 | 51647 | 01925 | 3 | 98075 | 4 |
| 57 | 44 24 | 15 36 | 46469 | 41 | 53531 | 48398 | 44 | 51602 | 01929 | 4 | 98071 | 3 |
| 58 | 44 16 | 15 44 | 46511 | 41 | 53489 | 48443 | 45 | 51557 | 01933 | 4 | 98067 | 2 |
| 59 | 44 8 | 15 52 | 46552 | 42 | 53448 | 48489 | 46 | 51511 | 01937 | 4 | 98063 | 1 |
| 60 | 44 0 | 16 0 | 46594 | 43 | 53406 | 48534 | 46 | 51466 | 01940 | 4 | 98060 | 0 |

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78°

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|

SINES, TANGENTS, AND SECANTS.

17°

162°

| M. | Hour T. A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|---------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 9 44 0 | 2 16 0 | 9.46594 | 0 | 10.53406 | 9.48534 | 0 | 10.51466 | 10.01940 | 0 | 9.98060 | 60 |
| 1 | 43 52 | 16 8 | 46635 | 1 | 53355 | 48579 | 1 | 51421 | 01944 | 0 | 98056 | 59 |
| 2 | 43 44 | 16 16 | 46676 | 1 | 53324 | 48624 | 1 | 51376 | 01948 | 0 | 98052 | 58 |
| 3 | 43 36 | 16 24 | 46717 | 2 | 53283 | 48669 | 2 | 51331 | 01952 | 0 | 98048 | 57 |
| 4 | 43 28 | 16 32 | 46758 | 3 | 53242 | 48714 | 3 | 51286 | 01956 | 0 | 98044 | 56 |
| 5 | 9 43 20 | 2 16 40 | 9.46800 | 3 | 10.53200 | 9.48759 | 4 | 10.51241 | 10.01960 | 0 | 9.98040 | 55 |
| 6 | 43 12 | 16 48 | 46841 | 4 | 53159 | 48804 | 4 | 51196 | 01964 | 0 | 98036 | 54 |
| 7 | 43 4 | 16 56 | 46882 | 5 | 53118 | 48849 | 5 | 51151 | 01968 | 0 | 98032 | 53 |
| 8 | 42 56 | 17 4 | 46923 | 5 | 53077 | 48894 | 6 | 51106 | 01971 | 1 | 98029 | 52 |
| 9 | 42 48 | 17 12 | 46964 | 6 | 53036 | 48939 | 7 | 51061 | 01975 | 1 | 98025 | 51 |
| 10 | 9 42 40 | 2 17 20 | 9.47005 | 7 | 10.52995 | 9.48984 | 7 | 10.51016 | 10.01979 | 1 | 9.98021 | 50 |
| 11 | 42 32 | 17 28 | 47045 | 7 | 52955 | 49029 | 8 | 50971 | 01983 | 1 | 98017 | 49 |
| 12 | 42 24 | 17 36 | 47086 | 8 | 52914 | 49073 | 9 | 50927 | 01987 | 1 | 98013 | 48 |
| 13 | 42 16 | 17 44 | 47127 | 9 | 52873 | 49118 | 10 | 50882 | 01991 | 1 | 98009 | 47 |
| 14 | 42 8 | 17 52 | 47168 | 9 | 52832 | 49163 | 10 | 50837 | 01995 | 1 | 98005 | 46 |
| 15 | 9 42 0 | 2 18 0 | 9.47209 | 10 | 10.52791 | 9.49207 | 11 | 10.50793 | 10.01999 | 1 | 9.98001 | 45 |
| 16 | 41 52 | 18 8 | 47249 | 11 | 52751 | 49252 | 12 | 50748 | 02003 | 1 | 97997 | 44 |
| 17 | 41 44 | 18 16 | 47290 | 11 | 52710 | 49296 | 12 | 50704 | 02007 | 1 | 97993 | 43 |
| 18 | 41 36 | 18 24 | 47330 | 12 | 52670 | 49341 | 13 | 50659 | 02011 | 1 | 97989 | 42 |
| 19 | 41 28 | 18 32 | 47371 | 13 | 52629 | 49385 | 14 | 50615 | 02014 | 1 | 97986 | 41 |
| 20 | 9 41 20 | 2 18 40 | 9.47411 | 13 | 10.52589 | 9.49430 | 15 | 10.50570 | 10.02018 | 1 | 9.97982 | 40 |
| 21 | 41 12 | 18 48 | 47452 | 14 | 52548 | 49474 | 15 | 50526 | 02022 | 1 | 97978 | 39 |
| 22 | 41 4 | 18 56 | 47492 | 15 | 52508 | 49519 | 16 | 50481 | 02026 | 1 | 97974 | 38 |
| 23 | 40 56 | 19 4 | 47533 | 15 | 52467 | 49563 | 17 | 50437 | 02030 | 2 | 97970 | 37 |
| 24 | 40 48 | 19 12 | 47573 | 16 | 52427 | 49607 | 18 | 50393 | 02034 | 2 | 97966 | 36 |
| 25 | 9 40 40 | 2 19 20 | 9.47613 | 17 | 10.52387 | 9.49652 | 18 | 10.50348 | 10.02038 | 2 | 9.97962 | 35 |
| 26 | 40 32 | 19 28 | 47654 | 17 | 52346 | 49696 | 19 | 50304 | 02042 | 2 | 97958 | 34 |
| 27 | 40 24 | 19 36 | 47694 | 18 | 52306 | 49740 | 20 | 50260 | 02046 | 2 | 97954 | 33 |
| 28 | 40 16 | 19 44 | 47734 | 19 | 52266 | 49784 | 21 | 50216 | 02050 | 2 | 97950 | 32 |
| 29 | 40 8 | 19 52 | 47774 | 19 | 52226 | 49828 | 21 | 50172 | 02054 | 2 | 97946 | 31 |
| 30 | 9 40 0 | 2 20 0 | 9.47814 | 20 | 10.52186 | 9.49872 | 22 | 10.50128 | 10.02058 | 2 | 9.97942 | 30 |
| 31 | 39 52 | 20 8 | 47854 | 21 | 52146 | 49916 | 23 | 50084 | 02062 | 2 | 97938 | 29 |
| 32 | 39 44 | 20 16 | 47894 | 21 | 52106 | 49960 | 24 | 50040 | 02066 | 2 | 97934 | 28 |
| 33 | 39 36 | 20 24 | 47934 | 22 | 52066 | 50004 | 24 | 49996 | 02070 | 2 | 97930 | 27 |
| 34 | 39 28 | 20 32 | 47974 | 23 | 52026 | 50048 | 25 | 49952 | 02074 | 2 | 97926 | 26 |
| 35 | 9 39 20 | 2 20 40 | 9.48014 | 23 | 10.51980 | 9.50092 | 26 | 10.49908 | 10.02078 | 2 | 9.97922 | 25 |
| 36 | 39 12 | 20 48 | 48054 | 24 | 51946 | 50136 | 26 | 49864 | 02082 | 2 | 97918 | 24 |
| 37 | 39 4 | 20 56 | 48094 | 25 | 51906 | 50180 | 27 | 49820 | 02086 | 2 | 97914 | 23 |
| 38 | 38 56 | 21 4 | 48133 | 25 | 51867 | 50223 | 28 | 49777 | 02090 | 3 | 97910 | 22 |
| 39 | 38 48 | 21 12 | 48173 | 26 | 51827 | 50267 | 29 | 49733 | 02094 | 3 | 97906 | 21 |
| 40 | 9 38 40 | 2 21 20 | 9.48213 | 27 | 10.51787 | 9.50311 | 29 | 10.49689 | 10.02098 | 3 | 9.97902 | 20 |
| 41 | 38 32 | 21 28 | 48252 | 27 | 51748 | 50355 | 30 | 49645 | 02102 | 3 | 97898 | 19 |
| 42 | 38 24 | 21 36 | 48292 | 28 | 51708 | 50398 | 31 | 49602 | 02106 | 3 | 97894 | 18 |
| 43 | 38 16 | 21 44 | 48332 | 29 | 51668 | 50442 | 32 | 49558 | 02110 | 3 | 97890 | 17 |
| 44 | 38 8 | 21 52 | 48371 | 29 | 51629 | 50485 | 32 | 49515 | 02114 | 3 | 97886 | 16 |
| 45 | 9 38 0 | 2 22 0 | 9.48411 | 30 | 10.51589 | 9.50529 | 33 | 10.49471 | 10.02118 | 3 | 9.97882 | 15 |
| 46 | 37 52 | 22 8 | 48450 | 31 | 51550 | 50572 | 34 | 49428 | 02122 | 3 | 97878 | 14 |
| 47 | 37 44 | 22 16 | 48490 | 31 | 51510 | 50616 | 35 | 49384 | 02126 | 3 | 97874 | 13 |
| 48 | 37 36 | 22 24 | 48529 | 32 | 51471 | 50659 | 35 | 49341 | 02130 | 3 | 97870 | 12 |
| 49 | 37 28 | 22 32 | 48568 | 33 | 51432 | 50703 | 36 | 49297 | 02134 | 3 | 97866 | 11 |
| 50 | 9 37 20 | 2 22 40 | 9.48607 | 33 | 10.51393 | 9.50746 | 37 | 10.49254 | 10.02139 | 3 | 9.97861 | 10 |
| 51 | 37 12 | 22 48 | 48647 | 34 | 51353 | 50789 | 37 | 49211 | 02143 | 3 | 97857 | 9 |
| 52 | 37 4 | 22 56 | 48686 | 35 | 51314 | 50833 | 38 | 49167 | 02147 | 3 | 97853 | 8 |
| 53 | 36 56 | 23 4 | 48725 | 35 | 51275 | 50876 | 39 | 49124 | 02151 | 4 | 97849 | 7 |
| 54 | 36 48 | 23 12 | 48764 | 36 | 51236 | 50919 | 40 | 49081 | 02155 | 4 | 97845 | 6 |
| 55 | 9 36 40 | 2 23 20 | 9.48803 | 37 | 10.51197 | 9.50962 | 40 | 10.49038 | 10.02159 | 4 | 9.97841 | 5 |
| 56 | 36 32 | 23 28 | 48842 | 37 | 51158 | 51005 | 41 | 48995 | 02163 | 4 | 97837 | 4 |
| 57 | 36 24 | 23 36 | 48881 | 38 | 51119 | 51048 | 42 | 48952 | 02167 | 4 | 97833 | 3 |
| 58 | 36 16 | 23 44 | 48920 | 39 | 51080 | 51092 | 43 | 48908 | 02171 | 4 | 97829 | 2 |
| 59 | 36 8 | 23 52 | 48959 | 39 | 51041 | 51135 | 43 | 48865 | 02175 | 4 | 97825 | 1 |
| 60 | 36 0 | 24 0 | 48998 | 40 | 51002 | 51178 | 44 | 48822 | 02179 | 4 | 97821 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour a. m. | Hour p. m. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 9 36 0 | 2 24 0 | 9.48998 | 0 | 10.51002 | 9.51178 | 0 | 10.48822 | 10.02179 | 0 | 9.97821 | 60 |
| 1 | 35 52 | 24 8 | 49037 | 1 | 50963 | 51221 | 1 | 48779 | 02183 | 0 | 97817 | 59 |
| 2 | 35 44 | 24 16 | 49076 | 1 | 50924 | 51204 | 1 | 48736 | 02188 | 0 | 97812 | 58 |
| 3 | 35 36 | 24 24 | 49115 | 2 | 50885 | 51306 | 2 | 48694 | 02192 | 0 | 97808 | 57 |
| 4 | 35 28 | 24 32 | 49153 | 3 | 50847 | 51349 | 3 | 48651 | 02196 | 0 | 97804 | 56 |
| 5 | 9 35 20 | 2 24 40 | 9.49192 | 3 | 10.50808 | 9.51392 | 3 | 10.48608 | 10.02200 | 0 | 9.97800 | 55 |
| 6 | 35 12 | 24 48 | 49231 | 4 | 50769 | 51435 | 4 | 48565 | 02204 | 0 | 97796 | 54 |
| 7 | 35 4 | 24 56 | 49269 | 4 | 50731 | 51478 | 5 | 48522 | 02208 | 0 | 97792 | 53 |
| 8 | 34 56 | 25 4 | 49308 | 5 | 50692 | 51520 | 6 | 48480 | 02212 | 1 | 97788 | 52 |
| 9 | 34 48 | 25 12 | 49347 | 6 | 50653 | 51563 | 6 | 48437 | 02216 | 1 | 97784 | 51 |
| 10 | 9 34 40 | 2 25 20 | 9.49385 | 6 | 10.50615 | 9.51606 | 7 | 10.48394 | 10.02231 | 1 | 9.97779 | 50 |
| 11 | 34 32 | 25 28 | 49424 | 7 | 50576 | 51648 | 8 | 48352 | 02235 | 1 | 97775 | 49 |
| 12 | 34 24 | 25 36 | 49462 | 8 | 50538 | 51691 | 8 | 48309 | 02239 | 1 | 97771 | 48 |
| 13 | 34 16 | 25 44 | 49500 | 8 | 50500 | 51734 | 9 | 48266 | 02233 | 1 | 97767 | 47 |
| 14 | 34 8 | 25 52 | 49539 | 9 | 50461 | 51776 | 10 | 48224 | 02237 | 1 | 97763 | 46 |
| 15 | 9 34 0 | 2 26 0 | 9.49577 | 9 | 10.50423 | 9.51819 | 10 | 10.48181 | 10.02241 | 1 | 9.97759 | 45 |
| 16 | 33 52 | 26 8 | 49615 | 10 | 50385 | 51861 | 11 | 48139 | 02246 | 1 | 97754 | 44 |
| 17 | 33 44 | 26 16 | 49654 | 11 | 50346 | 51903 | 12 | 48097 | 02250 | 1 | 97750 | 43 |
| 18 | 33 36 | 26 24 | 49692 | 11 | 50308 | 51946 | 13 | 48054 | 02254 | 1 | 97746 | 42 |
| 19 | 33 28 | 26 32 | 49730 | 12 | 50270 | 51988 | 13 | 48012 | 02258 | 1 | 97742 | 41 |
| 20 | 9 33 20 | 2 26 40 | 9.49768 | 13 | 10.50232 | 9.52031 | 14 | 10.47969 | 10.02262 | 1 | 9.97738 | 40 |
| 21 | 33 12 | 26 48 | 49806 | 13 | 50194 | 52073 | 15 | 47927 | 02266 | 1 | 97734 | 39 |
| 22 | 33 4 | 26 56 | 49844 | 14 | 50156 | 52115 | 15 | 47885 | 02271 | 2 | 97729 | 38 |
| 23 | 32 56 | 27 4 | 49882 | 14 | 50118 | 52157 | 16 | 47843 | 02275 | 2 | 97725 | 37 |
| 24 | 32 48 | 27 12 | 49920 | 15 | 50080 | 52200 | 17 | 47800 | 02279 | 2 | 97721 | 36 |
| 25 | 9 32 40 | 2 27 20 | 9.49958 | 16 | 10.50042 | 9.52242 | 17 | 10.47758 | 10.02283 | 2 | 9.97717 | 35 |
| 26 | 32 32 | 27 28 | 49996 | 16 | 50004 | 52284 | 18 | 47716 | 02287 | 2 | 97713 | 34 |
| 27 | 32 24 | 27 36 | 50034 | 17 | 49966 | 52326 | 19 | 47674 | 02292 | 2 | 97708 | 33 |
| 28 | 32 16 | 27 44 | 50072 | 18 | 49928 | 52368 | 20 | 47632 | 02296 | 2 | 97704 | 32 |
| 29 | 32 8 | 27 52 | 50110 | 18 | 49890 | 52410 | 20 | 47590 | 02300 | 2 | 97700 | 31 |
| 30 | 9 32 0 | 2 28 0 | 9.50148 | 19 | 10.49852 | 9.52452 | 21 | 10.47548 | 10.02304 | 2 | 9.97696 | 30 |
| 31 | 31 52 | 28 8 | 50185 | 20 | 49815 | 52494 | 22 | 47506 | 02309 | 2 | 97691 | 29 |
| 32 | 31 44 | 28 16 | 50223 | 20 | 49777 | 52536 | 22 | 47464 | 02313 | 2 | 97687 | 28 |
| 33 | 31 36 | 28 24 | 50261 | 21 | 49739 | 52578 | 23 | 47422 | 02317 | 2 | 97683 | 27 |
| 34 | 31 28 | 28 32 | 50298 | 21 | 49702 | 52620 | 24 | 47380 | 02321 | 2 | 97679 | 26 |
| 35 | 9 31 20 | 2 28 40 | 9.50336 | 22 | 10.49664 | 9.52661 | 24 | 10.47339 | 10.02326 | 2 | 9.97674 | 25 |
| 36 | 31 12 | 28 48 | 50374 | 23 | 49626 | 52703 | 25 | 47297 | 02330 | 3 | 97670 | 24 |
| 37 | 31 4 | 28 56 | 50411 | 23 | 49589 | 52745 | 26 | 47255 | 02334 | 3 | 97666 | 23 |
| 38 | 30 56 | 29 4 | 50449 | 24 | 49551 | 52787 | 27 | 47213 | 02338 | 3 | 97662 | 22 |
| 39 | 30 48 | 29 12 | 50486 | 25 | 49514 | 52829 | 27 | 47171 | 02343 | 3 | 97657 | 21 |
| 40 | 9 30 40 | 2 29 20 | 9.50523 | 25 | 10.49477 | 9.52870 | 28 | 10.47130 | 10.02347 | 3 | 9.97653 | 20 |
| 41 | 30 32 | 29 28 | 50561 | 26 | 49439 | 52912 | 29 | 47088 | 02351 | 3 | 97649 | 19 |
| 42 | 30 24 | 29 36 | 50598 | 26 | 49402 | 52953 | 29 | 47047 | 02355 | 3 | 97645 | 18 |
| 43 | 30 16 | 29 44 | 50635 | 27 | 49365 | 52995 | 30 | 47005 | 02360 | 3 | 97640 | 17 |
| 44 | 30 8 | 29 52 | 50673 | 28 | 49327 | 53037 | 31 | 46963 | 02364 | 3 | 97636 | 16 |
| 45 | 9 30 0 | 2 30 0 | 9.50710 | 28 | 10.49290 | 9.53078 | 31 | 10.46922 | 10.02368 | 3 | 9.97632 | 15 |
| 46 | 29 52 | 30 8 | 50747 | 29 | 49253 | 53120 | 32 | 46880 | 02372 | 3 | 97628 | 14 |
| 47 | 29 44 | 30 16 | 50784 | 30 | 49216 | 53161 | 33 | 46839 | 02377 | 3 | 97623 | 13 |
| 48 | 29 36 | 30 24 | 50821 | 30 | 49179 | 53202 | 34 | 46798 | 02381 | 3 | 97619 | 12 |
| 49 | 29 28 | 30 32 | 50858 | 31 | 49142 | 53244 | 34 | 46756 | 02385 | 3 | 97615 | 11 |
| 50 | 9 29 20 | 2 30 40 | 9.50896 | 31 | 10.49104 | 9.53285 | 35 | 10.46715 | 10.02390 | 4 | 9.97610 | 10 |
| 51 | 29 12 | 30 48 | 50933 | 32 | 49067 | 53327 | 36 | 46673 | 02394 | 4 | 97606 | 9 |
| 52 | 29 4 | 30 56 | 50970 | 33 | 49030 | 53368 | 36 | 46632 | 02398 | 4 | 97602 | 8 |
| 53 | 28 56 | 31 4 | 51007 | 33 | 48993 | 53409 | 37 | 46591 | 02403 | 4 | 97597 | 7 |
| 54 | 28 48 | 31 12 | 51043 | 34 | 48957 | 53450 | 38 | 46550 | 02407 | 4 | 97593 | 6 |
| 55 | 9 28 40 | 2 31 20 | 9.51080 | 35 | 10.48920 | 9.53492 | 38 | 10.46508 | 10.02411 | 4 | 9.97589 | 5 |
| 56 | 28 32 | 31 28 | 51117 | 35 | 48883 | 53533 | 39 | 46467 | 02416 | 4 | 97584 | 4 |
| 57 | 28 24 | 31 36 | 51154 | 36 | 48846 | 53574 | 40 | 46426 | 02420 | 4 | 97580 | 3 |
| 58 | 28 16 | 31 44 | 51191 | 37 | 48809 | 53615 | 41 | 46385 | 02424 | 4 | 97576 | 2 |
| 59 | 28 8 | 31 52 | 51227 | 37 | 48773 | 53656 | 41 | 46344 | 02429 | 4 | 97571 | 1 |
| 60 | 28 0 | 32 0 | 51264 | 38 | 48736 | 53697 | 42 | 46303 | 02433 | 4 | 97567 | 0 |
| M. | Hour p. m. | Hour a. m. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 9 28 0 | 2 32 0 | 9. 51264 | 0 | 10. 48736 | 9. 53697 | 0 | 10. 46303 | 10. 02433 | 0 | 9. 97567 | 60 |
| 1 | 27 52 | 32 8 | 51301 | 1 | 48699 | 53738 | 1 | 46262 | 02437 | 0 | 97563 | 59 |
| 2 | 27 44 | 32 16 | 51338 | 1 | 48662 | 53779 | 1 | 46221 | 02442 | 0 | 97558 | 58 |
| 3 | 27 36 | 32 24 | 51374 | 2 | 48626 | 53820 | 2 | 46180 | 02446 | 0 | 97554 | 57 |
| 4 | 27 28 | 32 32 | 51411 | 2 | 48589 | 53861 | 3 | 46139 | 02450 | 0 | 97550 | 56 |
| 5 | 9 27 20 | 2 32 40 | 9. 51447 | 3 | 10. 48553 | 9. 53902 | 3 | 10. 46098 | 10. 02455 | 0 | 9. 97545 | 55 |
| 6 | 27 12 | 32 48 | 51484 | 4 | 48516 | 53943 | 4 | 46057 | 02459 | 0 | 97541 | 54 |
| 7 | 27 4 | 32 56 | 51520 | 4 | 48480 | 53984 | 5 | 46016 | 02464 | 1 | 97536 | 53 |
| 8 | 26 56 | 33 4 | 51557 | 5 | 48443 | 54025 | 5 | 45975 | 02468 | 1 | 97532 | 52 |
| 9 | 26 48 | 33 12 | 51593 | 5 | 48407 | 54065 | 6 | 45935 | 02472 | 1 | 97528 | 51 |
| 10 | 9 26 40 | 2 33 20 | 9. 51629 | 6 | 10. 48371 | 9. 54106 | 7 | 10. 45894 | 10. 02477 | 1 | 9. 95523 | 50 |
| 11 | 26 32 | 33 28 | 51666 | 7 | 48334 | 54147 | 7 | 45853 | 02481 | 1 | 97519 | 49 |
| 12 | 26 24 | 33 36 | 51702 | 7 | 48298 | 54187 | 8 | 45813 | 02485 | 1 | 97515 | 48 |
| 13 | 26 16 | 33 44 | 51738 | 8 | 48262 | 54228 | 9 | 45772 | 02490 | 1 | 97510 | 47 |
| 14 | 26 8 | 33 52 | 51774 | 8 | 48226 | 54269 | 9 | 45731 | 02494 | 1 | 97506 | 46 |
| 15 | 9 26 0 | 2 34 0 | 9. 51811 | 9 | 10. 48189 | 9. 54309 | 10 | 10. 45691 | 10. 02499 | 1 | 9. 97501 | 45 |
| 16 | 25 52 | 34 8 | 51847 | 10 | 48153 | 54350 | 11 | 45650 | 02503 | 1 | 97497 | 44 |
| 17 | 25 44 | 34 16 | 51883 | 10 | 48117 | 54391 | 11 | 45610 | 02508 | 1 | 97492 | 43 |
| 18 | 25 36 | 34 24 | 51919 | 11 | 48081 | 54431 | 12 | 45569 | 02512 | 1 | 97488 | 42 |
| 19 | 25 28 | 34 32 | 51955 | 11 | 48045 | 54471 | 13 | 45529 | 02516 | 1 | 97484 | 41 |
| 20 | 9 25 20 | 2 34 40 | 9. 51991 | 12 | 10. 48009 | 9. 54512 | 13 | 10. 45488 | 10. 02521 | 1 | 9. 97479 | 40 |
| 21 | 25 12 | 34 48 | 52027 | 12 | 47973 | 54552 | 14 | 45448 | 02525 | 2 | 97475 | 39 |
| 22 | 25 4 | 34 56 | 52063 | 13 | 47937 | 54593 | 15 | 45407 | 02530 | 2 | 97470 | 38 |
| 23 | 24 56 | 35 4 | 52099 | 14 | 47901 | 54633 | 15 | 45367 | 02534 | 2 | 97466 | 37 |
| 24 | 24 48 | 35 12 | 52135 | 14 | 47865 | 54673 | 16 | 45327 | 02539 | 2 | 97461 | 36 |
| 25 | 9 24 40 | 2 35 20 | 9. 52171 | 15 | 10. 47829 | 9. 54714 | 17 | 10. 45286 | 10. 02543 | 2 | 9. 97457 | 35 |
| 26 | 24 32 | 35 28 | 52207 | 15 | 47793 | 54754 | 17 | 45246 | 02547 | 2 | 97453 | 34 |
| 27 | 24 24 | 35 36 | 52242 | 16 | 47758 | 54794 | 18 | 45206 | 02552 | 2 | 97448 | 33 |
| 28 | 24 16 | 35 44 | 52278 | 17 | 47722 | 54835 | 19 | 45165 | 02556 | 2 | 97444 | 32 |
| 29 | 24 8 | 35 52 | 52314 | 17 | 47686 | 54875 | 19 | 45125 | 02561 | 2 | 97439 | 31 |
| 30 | 9 24 0 | 2 36 0 | 9. 52350 | 18 | 10. 47650 | 9. 54915 | 20 | 10. 45085 | 10. 02565 | 2 | 9. 97435 | 30 |
| 31 | 23 52 | 36 8 | 52385 | 18 | 47615 | 54955 | 21 | 45045 | 02570 | 2 | 97430 | 29 |
| 32 | 23 44 | 36 16 | 52421 | 19 | 47579 | 54995 | 21 | 45005 | 02574 | 2 | 97426 | 28 |
| 33 | 23 36 | 36 24 | 52456 | 20 | 47544 | 55035 | 22 | 44965 | 02579 | 2 | 97421 | 27 |
| 34 | 23 28 | 36 32 | 52492 | 20 | 47508 | 55075 | 23 | 44925 | 02583 | 3 | 97417 | 26 |
| 35 | 9 23 20 | 2 36 40 | 9. 52527 | 21 | 10. 47473 | 9. 55115 | 23 | 10. 44885 | 10. 02588 | 3 | 9. 97412 | 25 |
| 36 | 23 12 | 36 48 | 52563 | 21 | 47437 | 55155 | 24 | 44845 | 02592 | 3 | 97408 | 24 |
| 37 | 23 4 | 36 56 | 52598 | 22 | 47402 | 55195 | 25 | 44805 | 02597 | 3 | 97403 | 23 |
| 38 | 22 56 | 37 4 | 52634 | 23 | 47366 | 55235 | 25 | 44765 | 02601 | 3 | 97399 | 22 |
| 39 | 22 48 | 37 12 | 52669 | 23 | 47331 | 55275 | 26 | 44725 | 02606 | 3 | 97394 | 21 |
| 40 | 9 22 40 | 2 37 20 | 9. 52705 | 24 | 10. 47295 | 9. 55315 | 27 | 10. 44685 | 10. 02610 | 3 | 9. 97390 | 20 |
| 41 | 22 32 | 37 28 | 52740 | 24 | 47260 | 55355 | 27 | 44645 | 02615 | 3 | 97385 | 19 |
| 42 | 22 24 | 37 36 | 52775 | 25 | 47225 | 55395 | 28 | 44605 | 02619 | 3 | 97381 | 18 |
| 43 | 22 16 | 37 44 | 52811 | 26 | 47189 | 55434 | 29 | 44566 | 02624 | 3 | 97376 | 17 |
| 44 | 22 8 | 37 52 | 52846 | 26 | 47154 | 55474 | 29 | 44526 | 02628 | 3 | 97372 | 16 |
| 45 | 9 22 0 | 2 38 0 | 9. 52881 | 27 | 10. 47119 | 9. 55514 | 30 | 10. 44486 | 10. 02633 | 3 | 9. 97367 | 15 |
| 46 | 21 52 | 38 8 | 52916 | 27 | 47084 | 55554 | 31 | 44446 | 02637 | 3 | 97363 | 14 |
| 47 | 21 44 | 38 16 | 52951 | 28 | 47049 | 55593 | 31 | 44407 | 02642 | 3 | 97358 | 13 |
| 48 | 21 36 | 38 24 | 52986 | 29 | 47014 | 55633 | 32 | 44367 | 02647 | 4 | 97353 | 12 |
| 49 | 21 28 | 38 32 | 53021 | 29 | 46979 | 55673 | 33 | 44327 | 02651 | 4 | 97349 | 11 |
| 50 | 9 21 20 | 2 38 40 | 9. 53056 | 30 | 10. 46944 | 9. 55712 | 33 | 10. 44288 | 10. 02656 | 4 | 9. 97344 | 10 |
| 51 | 21 12 | 38 48 | 53092 | 30 | 46908 | 55752 | 34 | 44248 | 02660 | 4 | 97340 | 9 |
| 52 | 21 4 | 38 56 | 53126 | 31 | 46874 | 55791 | 35 | 44209 | 02665 | 4 | 97335 | 8 |
| 53 | 20 56 | 39 4 | 53161 | 32 | 46839 | 55831 | 35 | 44169 | 02669 | 4 | 97331 | 7 |
| 54 | 20 48 | 39 12 | 53196 | 32 | 46804 | 55870 | 36 | 44130 | 02674 | 4 | 97326 | 6 |
| 55 | 9 20 40 | 2 39 20 | 9. 53231 | 33 | 10. 46769 | 9. 55910 | 37 | 10. 44090 | 10. 02678 | 4 | 9. 97322 | 5 |
| 56 | 20 32 | 39 28 | 53266 | 33 | 46734 | 55949 | 37 | 44051 | 02683 | 4 | 97317 | 4 |
| 57 | 20 24 | 39 36 | 53301 | 34 | 46699 | 55989 | 38 | 44011 | 02688 | 4 | 97312 | 3 |
| 58 | 20 16 | 39 44 | 53336 | 34 | 46664 | 56028 | 39 | 43972 | 02692 | 4 | 97308 | 2 |
| 59 | 20 8 | 39 52 | 53370 | 35 | 46630 | 56067 | 39 | 43933 | 02697 | 4 | 97303 | 1 |
| 60 | 20 0 | 40 0 | 53405 | 36 | 46595 | 56107 | 40 | 43893 | 02701 | 4 | 97299 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

| 20° | | | | | | | | | | | | | 139° |
|-----|------------|------------|---------|-------|-----------|----------|-------|------------|----------|-------|---------|----|------|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | |
| 0 | 9 20 0 | 2 40 0 | 9.53405 | 0 | 10.46595 | 9.56107 | 0 | 10.43893 | 10.02701 | 0 | 9.97299 | 60 | |
| 1 | 19 52 | 40 8 | 53440 | 1 | 46560 | 56146 | 1 | 43854 | 02706 | 0 | 97294 | 59 | |
| 2 | 19 44 | 40 16 | 53475 | 1 | 46525 | 56185 | 1 | 43815 | 02711 | 0 | 97289 | 58 | |
| 3 | 19 36 | 40 24 | 53509 | 2 | 46491 | 56224 | 2 | 43776 | 02715 | 0 | 97285 | 57 | |
| 4 | 19 28 | 40 32 | 53544 | 2 | 46456 | 56264 | 3 | 43736 | 02720 | 0 | 97280 | 56 | |
| 5 | 9 19 20 | 2 40 40 | 9.53578 | 3 | 10.46422 | 9.56303 | 3 | 10.43697 | 10.02724 | 0 | 9.97276 | 55 | |
| 6 | 19 12 | 40 48 | 53613 | 3 | 46387 | 56342 | 4 | 43658 | 02729 | 0 | 97271 | 54 | |
| 7 | 19 4 | 40 56 | 53647 | 4 | 46353 | 56381 | 4 | 43619 | 02734 | 1 | 97266 | 53 | |
| 8 | 18 56 | 41 4 | 53682 | 5 | 46318 | 56420 | 5 | 43580 | 02738 | 1 | 97262 | 52 | |
| 9 | 18 48 | 41 12 | 53716 | 5 | 46284 | 56459 | 6 | 43541 | 02743 | 1 | 97257 | 51 | |
| 10 | 9 18 40 | 2 41 20 | 9.53751 | 6 | 10.46249 | 9.56498 | 6 | 10.43502 | 10.02748 | 1 | 9.97252 | 50 | |
| 11 | 18 32 | 41 28 | 53785 | 6 | 46215 | 56537 | 7 | 43463 | 02752 | 1 | 97248 | 49 | |
| 12 | 18 24 | 41 36 | 53819 | 7 | 46181 | 56576 | 8 | 43424 | 02757 | 1 | 97243 | 48 | |
| 13 | 18 16 | 41 44 | 53854 | 7 | 46146 | 56615 | 8 | 43385 | 02762 | 1 | 97238 | 47 | |
| 14 | 18 8 | 41 52 | 53888 | 8 | 46112 | 56654 | 9 | 43346 | 02766 | 1 | 97234 | 46 | |
| 15 | 9 18 0 | 2 42 0 | 9.53922 | 8 | 10.46078 | 9.56693 | 10 | 10.43307 | 10.02771 | 1 | 9.97229 | 45 | |
| 16 | 17 52 | 42 8 | 53957 | 9 | 46043 | 56732 | 10 | 43268 | 02776 | 1 | 97224 | 44 | |
| 17 | 17 44 | 42 16 | 53991 | 10 | 46009 | 56771 | 11 | 43229 | 02780 | 1 | 97220 | 43 | |
| 18 | 17 36 | 42 24 | 54025 | 10 | 45975 | 56810 | 12 | 43190 | 02785 | 1 | 97215 | 42 | |
| 19 | 17 28 | 42 32 | 54059 | 11 | 45941 | 56849 | 12 | 43151 | 02790 | 1 | 97210 | 41 | |
| 20 | 9 17 20 | 2 42 40 | 9.54093 | 11 | 10.45907 | 9.56887 | 13 | 10.43113 | 10.02794 | 2 | 9.97206 | 40 | |
| 21 | 17 12 | 42 48 | 54127 | 12 | 45873 | 56926 | 13 | 43074 | 02799 | 2 | 97201 | 39 | |
| 22 | 17 4 | 42 56 | 54161 | 12 | 45839 | 56965 | 14 | 43035 | 02804 | 2 | 97196 | 38 | |
| 23 | 16 56 | 43 4 | 54195 | 13 | 45805 | 57004 | 15 | 42996 | 02808 | 2 | 97192 | 37 | |
| 24 | 16 48 | 43 12 | 54229 | 14 | 45771 | 57042 | 15 | 42958 | 02813 | 2 | 97187 | 36 | |
| 25 | 9 16 40 | 2 43 20 | 9.54263 | 14 | 10.45737 | 9.57081 | 16 | 10.42919 | 10.02818 | 2 | 9.97182 | 35 | |
| 26 | 16 32 | 43 28 | 54297 | 15 | 45703 | 57120 | 17 | 42880 | 02822 | 2 | 97178 | 34 | |
| 27 | 16 24 | 43 36 | 54331 | 15 | 45669 | 57158 | 17 | 42842 | 02827 | 2 | 97173 | 33 | |
| 28 | 16 16 | 43 44 | 54365 | 16 | 45635 | 57197 | 18 | 42803 | 02832 | 2 | 97168 | 32 | |
| 29 | 16 8 | 43 52 | 54399 | 16 | 45601 | 57235 | 19 | 42765 | 02837 | 2 | 97163 | 31 | |
| 30 | 9 16 0 | 2 44 0 | 9.54433 | 17 | 10.45567 | 9.57274 | 19 | 10.42726 | 10.02841 | 2 | 9.97159 | 30 | |
| 31 | 15 52 | 44 8 | 54466 | 17 | 45534 | 57312 | 20 | 42688 | 02846 | 2 | 97154 | 29 | |
| 32 | 15 44 | 44 16 | 54500 | 18 | 45500 | 57351 | 21 | 42649 | 02851 | 3 | 97149 | 28 | |
| 33 | 15 36 | 44 24 | 54534 | 19 | 45466 | 57389 | 21 | 42611 | 02855 | 3 | 97145 | 27 | |
| 34 | 15 28 | 44 32 | 54567 | 19 | 45433 | 57428 | 22 | 42572 | 02860 | 3 | 97140 | 26 | |
| 35 | 9 15 20 | 2 44 40 | 9.54601 | 20 | 10.45399 | 9.57466 | 22 | 10.42534 | 10.02865 | 3 | 9.97135 | 25 | |
| 36 | 15 12 | 44 48 | 54635 | 20 | 45365 | 57504 | 23 | 42496 | 02870 | 3 | 97130 | 24 | |
| 37 | 15 4 | 44 56 | 54668 | 21 | 45332 | 57543 | 24 | 42457 | 02874 | 3 | 97126 | 23 | |
| 38 | 14 56 | 45 4 | 54702 | 21 | 45298 | 57581 | 24 | 42419 | 02879 | 3 | 97121 | 22 | |
| 39 | 14 48 | 45 12 | 54735 | 22 | 45265 | 57619 | 25 | 42381 | 02884 | 3 | 97116 | 21 | |
| 40 | 9 14 40 | 2 45 20 | 9.54769 | 23 | 10.45231 | 9.57658 | 26 | 10.42342 | 10.02889 | 3 | 9.97111 | 20 | |
| 41 | 14 32 | 45 28 | 54802 | 23 | 45198 | 57696 | 26 | 42304 | 02893 | 3 | 97107 | 19 | |
| 42 | 14 24 | 45 36 | 54836 | 24 | 45164 | 57734 | 27 | 42266 | 02898 | 3 | 97102 | 18 | |
| 43 | 14 16 | 45 44 | 54869 | 24 | 45131 | 57772 | 28 | 42228 | 02903 | 3 | 97097 | 17 | |
| 44 | 14 8 | 45 52 | 54903 | 25 | 45097 | 57810 | 28 | 42190 | 02908 | 3 | 97092 | 16 | |
| 45 | 9 14 0 | 2 46 0 | 9.54936 | 25 | 10.45064 | 9.57849 | 29 | 10.42151 | 10.02913 | 4 | 9.97087 | 15 | |
| 46 | 13 52 | 46 8 | 54969 | 26 | 45031 | 57887 | 30 | 42113 | 02917 | 4 | 97083 | 14 | |
| 47 | 13 44 | 46 16 | 55003 | 26 | 44997 | 57925 | 30 | 42075 | 02922 | 4 | 97078 | 13 | |
| 48 | 13 36 | 46 24 | 55036 | 27 | 44964 | 57963 | 31 | 42037 | 02927 | 4 | 97073 | 12 | |
| 49 | 13 28 | 46 32 | 55069 | 28 | 44931 | 58001 | 31 | 41999 | 02932 | 4 | 97068 | 11 | |
| 50 | 9 13 20 | 2 46 40 | 9.55102 | 28 | 10.44808 | 9.58039 | 32 | 10.41961 | 10.02937 | 4 | 9.97063 | 10 | |
| 51 | 13 12 | 46 48 | 55136 | 29 | 44864 | 58077 | 33 | 41923 | 02941 | 4 | 97059 | 9 | |
| 52 | 13 4 | 46 56 | 55169 | 29 | 44831 | 58115 | 33 | 41885 | 02946 | 4 | 97054 | 8 | |
| 53 | 12 56 | 47 4 | 55202 | 30 | 44798 | 58153 | 34 | 41847 | 02951 | 4 | 97049 | 7 | |
| 54 | 12 48 | 47 12 | 55235 | 30 | 44765 | 58191 | 35 | 41809 | 02956 | 4 | 97044 | 6 | |
| 55 | 9 12 40 | 2 47 20 | 9.55268 | 31 | 10.44732 | 9.58229 | 35 | 10.41771 | 10.02961 | 4 | 9.97039 | 5 | |
| 56 | 12 32 | 47 28 | 55301 | 32 | 44699 | 58267 | 36 | 41733 | 02965 | 4 | 97035 | 4 | |
| 57 | 12 24 | 47 36 | 55334 | 32 | 44666 | 58304 | 37 | 41696 | 02970 | 4 | 97030 | 3 | |
| 58 | 12 16 | 47 44 | 55367 | 33 | 44633 | 58342 | 37 | 41658 | 02975 | 5 | 97025 | 2 | |
| 59 | 12 8 | 47 52 | 55400 | 33 | 44600 | 58380 | 38 | 41620 | 02980 | 5 | 97020 | 1 | |
| 60 | 12 0 | 48 0 | 55433 | 34 | 44567 | 58418 | 39 | 41582 | 02985 | 5 | 97015 | 0 | |

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|

110°

60°

SINES, TANGENTS, AND SECANTS.

| 111° | | | | | | | | | | | | | 158° |
|------|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|------|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | |
| 0 | 9 12 0 | 2 48 0 | 9. 55433 | 0 | 10. 44567 | 9. 58418 | 0 | 10. 41582 | 10. 02985 | 0 | 9. 97015 | 60 | |
| 1 | 11 52 | 48 8 | 55466 | 1 | 44534 | 58455 | 1 | 41545 | 02990 | 0 | 97010 | 59 | |
| 2 | 11 44 | 48 16 | 55499 | 1 | 44501 | 58493 | 1 | 41507 | 02995 | 0 | 97005 | 58 | |
| 3 | 11 36 | 48 24 | 55532 | 2 | 44468 | 58531 | 2 | 41469 | 02999 | 0 | 97001 | 57 | |
| 4 | 11 28 | 48 32 | 55564 | 2 | 44436 | 58569 | 2 | 41431 | 03004 | 0 | 96996 | 56 | |
| 5 | 9 11 20 | 2 48 40 | 9. 55597 | 3 | 10. 44403 | 9. 58606 | 3 | 10. 41394 | 10. 03009 | 0 | 9. 96991 | 55 | |
| 6 | 11 12 | 48 48 | 55630 | 3 | 44370 | 58644 | 4 | 41356 | 03014 | 0 | 96986 | 54 | |
| 7 | 11 4 | 48 56 | 55663 | 4 | 44337 | 58681 | 4 | 41319 | 03019 | 1 | 96981 | 53 | |
| 8 | 10 56 | 49 4 | 55695 | 4 | 44305 | 58719 | 5 | 41281 | 03024 | 1 | 96976 | 52 | |
| 9 | 10 48 | 49 12 | 55728 | 5 | 44272 | 58757 | 6 | 41243 | 03029 | 1 | 96971 | 51 | |
| 10 | 9 10 40 | 2 49 20 | 9. 55761 | 5 | 10. 44239 | 9. 58794 | 6 | 10. 41206 | 10. 03034 | 1 | 9. 96966 | 50 | |
| 11 | 10 32 | 49 28 | 55793 | 6 | 44207 | 58832 | 7 | 41168 | 03038 | 1 | 96962 | 49 | |
| 12 | 10 24 | 49 36 | 55826 | 6 | 44174 | 58869 | 7 | 41131 | 03043 | 1 | 96957 | 48 | |
| 13 | 10 16 | 49 44 | 55858 | 7 | 44142 | 58907 | 8 | 41093 | 03048 | 1 | 96952 | 47 | |
| 14 | 10 8 | 49 52 | 55891 | 7 | 44109 | 58944 | 9 | 41056 | 03053 | 1 | 96947 | 46 | |
| 15 | 9 10 0 | 2 50 0 | 9. 55923 | 8 | 10. 44077 | 9. 58981 | 9 | 10. 41019 | 10. 03058 | 1 | 9. 96942 | 45 | |
| 16 | 9 52 | 50 8 | 55956 | 9 | 44044 | 59019 | 10 | 40981 | 03063 | 1 | 96937 | 44 | |
| 17 | 9 44 | 50 16 | 55988 | 9 | 44012 | 59056 | 10 | 40944 | 03068 | 1 | 96932 | 43 | |
| 18 | 9 36 | 50 24 | 56021 | 10 | 43979 | 59094 | 11 | 40906 | 03073 | 1 | 96927 | 42 | |
| 19 | 9 28 | 50 32 | 56053 | 10 | 43947 | 59131 | 12 | 40869 | 03078 | 2 | 96922 | 41 | |
| 20 | 9 9 20 | 2 50 40 | 9. 56085 | 11 | 10. 43915 | 9. 59168 | 12 | 10. 40832 | 10. 03083 | 2 | 9. 96917 | 40 | |
| 21 | 9 12 | 50 48 | 56118 | 11 | 43882 | 59205 | 13 | 40795 | 03088 | 2 | 96912 | 39 | |
| 22 | 9 4 | 50 56 | 56150 | 12 | 43850 | 59243 | 14 | 40757 | 03093 | 2 | 96907 | 38 | |
| 23 | 8 56 | 51 4 | 56182 | 12 | 43818 | 59280 | 14 | 40720 | 03097 | 2 | 96903 | 37 | |
| 24 | 8 48 | 51 12 | 56215 | 13 | 43785 | 59317 | 15 | 40683 | 03102 | 2 | 96898 | 36 | |
| 25 | 9 8 40 | 2 51 20 | 9. 56247 | 13 | 10. 43753 | 9. 59354 | 15 | 10. 40646 | 10. 03107 | 2 | 9. 96893 | 35 | |
| 26 | 8 32 | 51 28 | 56279 | 14 | 43721 | 59391 | 16 | 40609 | 03112 | 2 | 96888 | 34 | |
| 27 | 8 24 | 51 36 | 56311 | 14 | 43689 | 59429 | 17 | 40571 | 03117 | 2 | 96883 | 33 | |
| 28 | 8 16 | 51 44 | 56343 | 15 | 43657 | 59466 | 17 | 40534 | 03122 | 2 | 96878 | 32 | |
| 29 | 8 8 | 51 52 | 56375 | 16 | 43625 | 59503 | 18 | 40497 | 03127 | 2 | 96873 | 31 | |
| 30 | 9 8 0 | 2 52 0 | 9. 56408 | 16 | 10. 43592 | 9. 59540 | 19 | 10. 40460 | 10. 03132 | 2 | 9. 96868 | 30 | |
| 31 | 7 52 | 52 8 | 56440 | 17 | 43560 | 59577 | 19 | 40423 | 03137 | 3 | 96863 | 29 | |
| 32 | 7 44 | 52 16 | 56472 | 17 | 43528 | 59614 | 20 | 40386 | 03142 | 3 | 96858 | 28 | |
| 33 | 7 36 | 52 24 | 56504 | 18 | 43496 | 59651 | 20 | 40349 | 03147 | 3 | 96853 | 27 | |
| 34 | 7 28 | 52 32 | 56536 | 18 | 43464 | 59688 | 21 | 40312 | 03152 | 3 | 96848 | 26 | |
| 35 | 9 7 20 | 2 52 40 | 9. 56568 | 19 | 10. 43432 | 9. 59725 | 22 | 10. 40275 | 10. 03157 | 3 | 9. 96843 | 25 | |
| 36 | 7 12 | 52 48 | 56599 | 19 | 43401 | 59762 | 22 | 40238 | 03162 | 3 | 96838 | 24 | |
| 37 | 7 4 | 52 56 | 56631 | 20 | 43369 | 59799 | 23 | 40201 | 03167 | 3 | 96833 | 23 | |
| 38 | 6 56 | 53 4 | 56663 | 20 | 43337 | 59835 | 23 | 40165 | 03172 | 3 | 96828 | 22 | |
| 39 | 6 48 | 53 12 | 56695 | 21 | 43305 | 59872 | 24 | 40128 | 03177 | 3 | 96823 | 21 | |
| 40 | 9 6 40 | 2 53 20 | 9. 56727 | 21 | 10. 43273 | 9. 59909 | 25 | 10. 40091 | 10. 03182 | 3 | 9. 96818 | 20 | |
| 41 | 6 32 | 53 28 | 56759 | 22 | 43241 | 59946 | 25 | 40054 | 03187 | 3 | 96813 | 19 | |
| 42 | 6 24 | 53 36 | 56790 | 22 | 43210 | 59983 | 26 | 40017 | 03192 | 3 | 96808 | 18 | |
| 43 | 6 16 | 53 44 | 56822 | 23 | 43178 | 60019 | 27 | 39981 | 03197 | 4 | 96803 | 17 | |
| 44 | 6 8 | 53 52 | 56854 | 24 | 43146 | 60056 | 27 | 39944 | 03202 | 4 | 96798 | 16 | |
| 45 | 9 6 0 | 2 54 0 | 9. 56886 | 24 | 10. 43114 | 9. 60093 | 28 | 10. 39907 | 10. 03207 | 4 | 9. 96793 | 15 | |
| 46 | 5 52 | 54 8 | 56917 | 25 | 43083 | 60130 | 28 | 39870 | 03212 | 4 | 96788 | 14 | |
| 47 | 5 44 | 54 16 | 56949 | 25 | 43051 | 60166 | 29 | 39834 | 03217 | 4 | 96783 | 13 | |
| 48 | 5 36 | 54 24 | 56980 | 26 | 43020 | 60203 | 30 | 39797 | 03222 | 4 | 96778 | 12 | |
| 49 | 5 28 | 54 32 | 57012 | 26 | 42988 | 60240 | 30 | 39760 | 03228 | 4 | 96772 | 11 | |
| 50 | 9 5 20 | 2 54 40 | 9. 57044 | 27 | 10. 42956 | 9. 60276 | 31 | 10. 39724 | 10. 03233 | 4 | 9. 96767 | 10 | |
| 51 | 5 12 | 54 48 | 57075 | 27 | 42925 | 60313 | 31 | 39687 | 03238 | 4 | 96762 | 9 | |
| 52 | 5 4 | 54 56 | 57107 | 28 | 42893 | 60349 | 32 | 39651 | 03243 | 4 | 96757 | 8 | |
| 53 | 4 56 | 55 4 | 57138 | 28 | 42862 | 60386 | 33 | 39614 | 03248 | 4 | 96752 | 7 | |
| 54 | 4 48 | 55 12 | 57169 | 29 | 42831 | 60422 | 33 | 39578 | 03253 | 4 | 96747 | 6 | |
| 55 | 9 4 40 | 2 55 20 | 9. 57201 | 29 | 10. 42799 | 9. 60459 | 34 | 10. 39541 | 10. 03258 | 5 | 9. 96742 | 5 | |
| 56 | 4 32 | 55 28 | 57232 | 30 | 42768 | 60495 | 35 | 39505 | 03263 | 5 | 96737 | 4 | |
| 57 | 4 24 | 55 36 | 57264 | 30 | 42736 | 60532 | 35 | 39468 | 03268 | 5 | 96732 | 3 | |
| 58 | 4 16 | 55 44 | 57295 | 31 | 42705 | 60568 | 36 | 39432 | 03273 | 5 | 96727 | 2 | |
| 59 | 4 8 | 55 52 | 57326 | 32 | 42674 | 60605 | 36 | 39395 | 03278 | 5 | 96722 | 1 | |
| 60 | 4 0 | 56 0 | 57358 | 32 | 42642 | 60641 | 37 | 39359 | 03283 | 5 | 96717 | 0 | |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. | |
| 111° | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | |
| 68° | | | | | | | | | | | | | |

SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 9 4 0 | 2 56 0 | 9. 57358 | 0 | 10. 42642 | 9. 60641 | 0 | 10. 39359 | 10. 03283 | 0 | 9. 96717 | 60 |
| 1 | 3 52 | 56 8 | 57389 | 1 | 42611 | 60677 | 1 | 39323 | 03289 | 0 | 96711 | 59 |
| 2 | 3 44 | 56 16 | 57420 | 1 | 42580 | 60714 | 1 | 39286 | 03294 | 0 | 96706 | 58 |
| 3 | 3 36 | 56 24 | 57451 | 2 | 42549 | 60750 | 2 | 39250 | 03299 | 0 | 96701 | 57 |
| 4 | 3 28 | 56 32 | 57482 | 2 | 42518 | 60786 | 2 | 39214 | 03304 | 0 | 96696 | 56 |
| 5 | 9 3 20 | 2 56 40 | 9. 57514 | 3 | 10. 42486 | 9. 60823 | 3 | 10. 39177 | 10. 03309 | 0 | 9. 96691 | 55 |
| 6 | 3 12 | 56 48 | 57545 | 3 | 42455 | 60859 | 4 | 39141 | 03314 | 1 | 96686 | 54 |
| 7 | 3 4 | 56 56 | 57576 | 4 | 42424 | 60895 | 4 | 39105 | 03319 | 1 | 96681 | 53 |
| 8 | 2 56 | 57 4 | 57607 | 4 | 42393 | 60931 | 5 | 39069 | 03324 | 1 | 96676 | 52 |
| 9 | 2 48 | 57 12 | 57638 | 5 | 42362 | 60967 | 5 | 39033 | 03330 | 1 | 96670 | 51 |
| 10 | 9 2 40 | 2 57 20 | 9. 57669 | 5 | 10. 42331 | 9. 61004 | 6 | 10. 38996 | 10. 03335 | 1 | 9. 96665 | 50 |
| 11 | 2 32 | 57 28 | 57700 | 6 | 42300 | 61040 | 7 | 38960 | 03340 | 1 | 96660 | 49 |
| 12 | 2 24 | 57 36 | 57731 | 6 | 42269 | 61076 | 7 | 38924 | 03345 | 1 | 96655 | 48 |
| 13 | 2 16 | 57 44 | 57762 | 7 | 42238 | 61112 | 8 | 38888 | 03350 | 1 | 96650 | 47 |
| 14 | 2 8 | 57 52 | 57793 | 7 | 42207 | 61148 | 8 | 38852 | 03355 | 1 | 96645 | 46 |
| 15 | 9 2 0 | 2 58 0 | 9. 57824 | 8 | 10. 42176 | 9. 61184 | 9 | 10. 38816 | 10. 03360 | 1 | 9. 96640 | 45 |
| 16 | 1 52 | 58 8 | 57855 | 8 | 42145 | 61220 | 10 | 38780 | 03366 | 1 | 96634 | 44 |
| 17 | 1 44 | 58 16 | 57885 | 9 | 42115 | 61256 | 10 | 38744 | 03371 | 1 | 96629 | 43 |
| 18 | 1 36 | 58 24 | 57916 | 9 | 42084 | 61292 | 11 | 38708 | 03376 | 2 | 96624 | 42 |
| 19 | 1 28 | 58 32 | 57947 | 10 | 42053 | 61328 | 11 | 38672 | 03381 | 2 | 96619 | 41 |
| 20 | 9 1 20 | 2 58 40 | 9. 57978 | 10 | 10. 42022 | 9. 61364 | 12 | 10. 38636 | 10. 03386 | 2 | 9. 96614 | 40 |
| 21 | 1 12 | 58 48 | 58008 | 11 | 41992 | 61400 | 13 | 38600 | 03392 | 2 | 96608 | 39 |
| 22 | 1 4 | 58 56 | 58039 | 11 | 41961 | 61436 | 13 | 38564 | 03397 | 2 | 96603 | 38 |
| 23 | 0 56 | 59 4 | 58070 | 12 | 41930 | 61472 | 14 | 38528 | 03402 | 2 | 96598 | 37 |
| 24 | 0 48 | 59 12 | 58101 | 12 | 41899 | 61508 | 14 | 38492 | 03407 | 2 | 96593 | 36 |
| 25 | 9 0 40 | 2 59 20 | 9. 58131 | 13 | 10. 41869 | 9. 61544 | 15 | 10. 38456 | 10. 03412 | 2 | 9. 96588 | 35 |
| 26 | 0 32 | 59 28 | 58162 | 13 | 41838 | 61579 | 15 | 38421 | 03418 | 2 | 96582 | 34 |
| 27 | 0 24 | 59 36 | 58192 | 14 | 41808 | 61615 | 16 | 38385 | 03423 | 2 | 96577 | 33 |
| 28 | 0 16 | 59 44 | 58223 | 14 | 41777 | 61651 | 17 | 38349 | 03428 | 2 | 96572 | 32 |
| 29 | 0 8 | 59 52 | 58253 | 15 | 41747 | 61687 | 17 | 38313 | 03433 | 3 | 96567 | 31 |
| 30 | 9 0 0 | 3 0 0 | 9. 58284 | 15 | 10. 41716 | 9. 61722 | 18 | 10. 38278 | 10. 03438 | 3 | 9. 96562 | 30 |
| 31 | 8 59 52 | 0 8 | 58314 | 16 | 41686 | 61758 | 18 | 38242 | 03444 | 3 | 96556 | 29 |
| 32 | 59 44 | 0 16 | 58345 | 16 | 41655 | 61794 | 19 | 38206 | 03449 | 3 | 96551 | 28 |
| 33 | 59 36 | 0 24 | 58375 | 17 | 41625 | 61830 | 20 | 38170 | 03454 | 3 | 96546 | 27 |
| 34 | 59 28 | 0 32 | 58406 | 17 | 41594 | 61865 | 20 | 38135 | 03459 | 3 | 96541 | 26 |
| 35 | 8 59 20 | 3 0 40 | 9. 58436 | 18 | 10. 41564 | 9. 61900 | 21 | 10. 38099 | 10. 03465 | 3 | 9. 96535 | 25 |
| 36 | 59 12 | 0 48 | 58467 | 18 | 41533 | 61936 | 21 | 38064 | 03470 | 3 | 96530 | 24 |
| 37 | 59 4 | 0 56 | 58497 | 19 | 41503 | 61972 | 22 | 38028 | 03475 | 3 | 96525 | 23 |
| 38 | 58 56 | 1 4 | 58527 | 19 | 41473 | 62008 | 23 | 37992 | 03480 | 3 | 96520 | 22 |
| 39 | 58 48 | 1 12 | 58557 | 20 | 41443 | 62043 | 23 | 37957 | 03486 | 3 | 96514 | 21 |
| 40 | 8 58 40 | 3 1 20 | 9. 58588 | 20 | 10. 41412 | 9. 62079 | 24 | 10. 37921 | 10. 03491 | 3 | 9. 96509 | 20 |
| 41 | 58 32 | 1 28 | 58618 | 21 | 41382 | 62114 | 24 | 37886 | 03496 | 4 | 96504 | 19 |
| 42 | 58 24 | 1 36 | 58648 | 21 | 41352 | 62150 | 25 | 37850 | 03502 | 4 | 96498 | 18 |
| 43 | 58 16 | 1 44 | 58678 | 22 | 41322 | 62185 | 26 | 37815 | 03507 | 4 | 96493 | 17 |
| 44 | 58 8 | 1 52 | 58709 | 22 | 41291 | 62221 | 26 | 37779 | 03512 | 4 | 96488 | 16 |
| 45 | 8 58 0 | 3 2 0 | 9. 58739 | 23 | 10. 41261 | 9. 62256 | 27 | 10. 37744 | 10. 03517 | 4 | 9. 96483 | 15 |
| 46 | 57 52 | 2 8 | 58769 | 23 | 41231 | 62292 | 27 | 37708 | 03523 | 4 | 96477 | 14 |
| 47 | 57 44 | 2 16 | 58799 | 24 | 41201 | 62327 | 28 | 37673 | 03528 | 4 | 96472 | 13 |
| 48 | 57 36 | 2 24 | 58829 | 24 | 41171 | 62362 | 29 | 37638 | 03533 | 4 | 96467 | 12 |
| 49 | 57 28 | 2 32 | 58859 | 25 | 41141 | 62398 | 29 | 37602 | 03539 | 4 | 96461 | 11 |
| 50 | 8 57 20 | 3 2 40 | 9. 58889 | 25 | 10. 41111 | 9. 62433 | 30 | 10. 37567 | 10. 03544 | 4 | 9. 96456 | 10 |
| 51 | 57 12 | 2 48 | 58919 | 26 | 41081 | 62468 | 30 | 37532 | 03549 | 4 | 96451 | 9 |
| 52 | 57 4 | 2 56 | 58949 | 26 | 41051 | 62504 | 31 | 37496 | 03555 | 5 | 96445 | 8 |
| 53 | 56 56 | 3 4 | 58979 | 27 | 41021 | 62539 | 32 | 37461 | 03560 | 5 | 96440 | 7 |
| 54 | 56 48 | 3 12 | 59009 | 27 | 40991 | 62574 | 32 | 37426 | 03565 | 5 | 96435 | 6 |
| 55 | 8 56 40 | 3 3 20 | 9. 59039 | 28 | 10. 40961 | 9. 62609 | 33 | 10. 37391 | 10. 03571 | 5 | 9. 96429 | 5 |
| 56 | 56 32 | 3 28 | 59069 | 28 | 40931 | 62645 | 33 | 37355 | 03576 | 5 | 96424 | 4 |
| 57 | 56 24 | 3 36 | 59098 | 29 | 40902 | 62680 | 34 | 37320 | 03581 | 5 | 96419 | 3 |
| 58 | 56 16 | 3 44 | 59128 | 29 | 40872 | 62715 | 35 | 37285 | 03587 | 5 | 96413 | 2 |
| 59 | 56 8 | 3 52 | 59158 | 30 | 40842 | 62750 | 35 | 37250 | 03592 | 5 | 96408 | 1 |
| 60 | 56 0 | 4 0 | 59188 | 31 | 40812 | 62785 | 36 | 37215 | 03597 | 5 | 96403 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

SINES, TANGENTS, AND SECANTS.

| 23° | | | | | | | | | | | | 156° |
|-----|------------|------------|----------|-------|-----------|----------|-------|------------|-----------|-------|----------|------|
| N. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
| 0 | 8 56 0 | 3 4 0 | 9. 59188 | 0 | 10. 40812 | 9. 62785 | 0 | 10. 37215 | 10. 03597 | 0 | 9. 96403 | 60 |
| 1 | 55 52 | 4 8 | 59218 | 0 | 40782 | 62820 | 1 | 37180 | 03603 | 0 | 96397 | 59 |
| 2 | 55 44 | 4 16 | 59247 | 1 | 40753 | 62855 | 1 | 37145 | 03608 | 0 | 96392 | 58 |
| 3 | 55 36 | 4 24 | 59277 | 1 | 40723 | 62890 | 2 | 37110 | 03613 | 0 | 96387 | 57 |
| 4 | 55 28 | 4 32 | 59307 | 2 | 40693 | 62926 | 2 | 37074 | 03619 | 0 | 96381 | 56 |
| 5 | 8 55 20 | 3 4 40 | 9. 59336 | 2 | 10. 40664 | 9. 62961 | 3 | 10. 37039 | 10. 03624 | 0 | 9. 96376 | 55 |
| 6 | 55 12 | 4 48 | 59366 | 3 | 40634 | 62996 | 3 | 37004 | 03630 | 1 | 96370 | 54 |
| 7 | 55 4 | 4 56 | 59396 | 3 | 40604 | 63031 | 4 | 36969 | 03635 | 1 | 96365 | 53 |
| 8 | 54 56 | 5 4 | 59425 | 4 | 40575 | 63066 | 5 | 36934 | 03640 | 1 | 96360 | 52 |
| 9 | 54 48 | 5 12 | 59455 | 4 | 40545 | 63101 | 5 | 36899 | 03646 | 1 | 96354 | 51 |
| 10 | 8 54 40 | 3 5 20 | 9. 59484 | 5 | 10. 40516 | 9. 63135 | 6 | 10. 36865 | 10. 03651 | 1 | 9. 96349 | 50 |
| 11 | 54 32 | 5 28 | 59514 | 5 | 40486 | 63170 | 6 | 36830 | 03657 | 1 | 96343 | 49 |
| 12 | 54 24 | 5 36 | 59543 | 6 | 40457 | 63205 | 7 | 36795 | 03662 | 1 | 96338 | 48 |
| 13 | 54 16 | 5 44 | 59573 | 6 | 40427 | 63240 | 7 | 36760 | 03667 | 1 | 96333 | 47 |
| 14 | 54 8 | 5 52 | 59602 | 7 | 40398 | 63275 | 8 | 36725 | 03673 | 1 | 96327 | 46 |
| 15 | 8 54 0 | 3 6 0 | 9. 59632 | 7 | 10. 40368 | 9. 63310 | 9 | 10. 36690 | 10. 03678 | 1 | 9. 96322 | 45 |
| 16 | 53 52 | 6 8 | 59661 | 8 | 40339 | 63345 | 9 | 36655 | 03684 | 1 | 96316 | 44 |
| 17 | 53 44 | 6 16 | 59690 | 8 | 40310 | 63379 | 10 | 36621 | 03689 | 2 | 96311 | 43 |
| 18 | 53 36 | 6 24 | 59720 | 9 | 40280 | 63414 | 10 | 36586 | 03695 | 2 | 96305 | 42 |
| 19 | 53 28 | 6 32 | 59749 | 9 | 40251 | 63449 | 11 | 36551 | 03700 | 2 | 96300 | 41 |
| 20 | 8 53 20 | 3 6 40 | 9. 59778 | 10 | 10. 40222 | 9. 63484 | 12 | 10. 36516 | 10. 03706 | 2 | 9. 96294 | 40 |
| 21 | 53 12 | 6 48 | 59808 | 10 | 40192 | 63519 | 12 | 36481 | 03711 | 2 | 96289 | 39 |
| 22 | 53 4 | 6 56 | 59837 | 11 | 40163 | 63553 | 13 | 36447 | 03716 | 2 | 96284 | 38 |
| 23 | 52 56 | 7 4 | 59866 | 11 | 40134 | 63588 | 13 | 36412 | 03722 | 2 | 96278 | 37 |
| 24 | 52 48 | 7 12 | 59895 | 12 | 40105 | 63623 | 14 | 36377 | 03727 | 2 | 96273 | 36 |
| 25 | 8 52 40 | 3 7 20 | 9. 59924 | 12 | 10. 40076 | 9. 63657 | 14 | 10. 36343 | 10. 03733 | 2 | 9. 96267 | 35 |
| 26 | 52 32 | 7 28 | 59954 | 13 | 40046 | 63692 | 15 | 36308 | 03738 | 2 | 96262 | 34 |
| 27 | 52 24 | 7 36 | 59983 | 13 | 40017 | 63726 | 16 | 36274 | 03744 | 2 | 96256 | 33 |
| 28 | 52 16 | 7 44 | 60012 | 14 | 39988 | 63761 | 16 | 36239 | 03749 | 3 | 96251 | 32 |
| 29 | 52 8 | 7 52 | 60041 | 14 | 39959 | 63796 | 17 | 36204 | 03755 | 3 | 96245 | 31 |
| 30 | 8 52 0 | 3 8 0 | 9. 60070 | 15 | 10. 39930 | 9. 63830 | 17 | 10. 36170 | 10. 03760 | 3 | 9. 96240 | 30 |
| 31 | 51 52 | 8 8 | 60099 | 15 | 39901 | 63865 | 18 | 36135 | 03766 | 3 | 96234 | 29 |
| 32 | 51 44 | 8 16 | 60128 | 15 | 39872 | 63899 | 18 | 36101 | 03771 | 3 | 96229 | 28 |
| 33 | 51 36 | 8 24 | 60157 | 16 | 39843 | 63934 | 19 | 36066 | 03777 | 3 | 96223 | 27 |
| 34 | 51 28 | 8 32 | 60186 | 16 | 39814 | 63968 | 20 | 36032 | 03782 | 3 | 96218 | 26 |
| 35 | 8 51 20 | 3 8 40 | 9. 60215 | 17 | 10. 39785 | 9. 64003 | 20 | 10. 35997 | 10. 03788 | 3 | 9. 96212 | 25 |
| 36 | 51 12 | 8 48 | 60244 | 17 | 39756 | 64037 | 21 | 35963 | 03793 | 3 | 96207 | 24 |
| 37 | 51 4 | 8 56 | 60273 | 18 | 39727 | 64072 | 21 | 35928 | 03799 | 3 | 96201 | 23 |
| 38 | 50 56 | 9 4 | 60302 | 18 | 39698 | 64106 | 22 | 35894 | 03804 | 3 | 96196 | 22 |
| 39 | 50 48 | 9 12 | 60331 | 19 | 39669 | 64140 | 22 | 35860 | 03810 | 4 | 96190 | 21 |
| 40 | 8 50 40 | 3 9 20 | 9. 60359 | 19 | 10. 39641 | 9. 64175 | 23 | 10. 35825 | 10. 03815 | 4 | 9. 96185 | 20 |
| 41 | 50 32 | 9 28 | 60388 | 20 | 39612 | 64209 | 24 | 35791 | 03821 | 4 | 96179 | 19 |
| 42 | 50 24 | 9 36 | 60417 | 20 | 39583 | 64243 | 24 | 35757 | 03826 | 4 | 96174 | 18 |
| 43 | 50 16 | 9 44 | 60446 | 21 | 39554 | 64278 | 25 | 35722 | 03832 | 4 | 96168 | 17 |
| 44 | 50 8 | 9 52 | 60474 | 21 | 39526 | 64312 | 25 | 35688 | 03838 | 4 | 96162 | 16 |
| 45 | 8 50 0 | 3 10 0 | 9. 60503 | 22 | 10. 39497 | 9. 64346 | 26 | 10. 35654 | 10. 03843 | 4 | 9. 96157 | 15 |
| 46 | 49 52 | 10 8 | 60532 | 22 | 39468 | 64381 | 26 | 35619 | 03849 | 4 | 96151 | 14 |
| 47 | 49 44 | 10 16 | 60561 | 23 | 39439 | 64415 | 27 | 35585 | 03854 | 4 | 96146 | 13 |
| 48 | 49 36 | 10 24 | 60589 | 23 | 39411 | 64449 | 28 | 35551 | 03860 | 4 | 96140 | 12 |
| 49 | 49 28 | 10 32 | 60618 | 24 | 39382 | 64483 | 28 | 35517 | 03865 | 4 | 96135 | 11 |
| 50 | 8 49 20 | 3 10 40 | 9. 60646 | 24 | 10. 39354 | 9. 64517 | 29 | 10. 35483 | 10. 03871 | 5 | 9. 96129 | 10 |
| 51 | 49 12 | 10 48 | 60675 | 25 | 39325 | 64552 | 29 | 35448 | 03877 | 5 | 96123 | 9 |
| 52 | 49 4 | 10 56 | 60704 | 25 | 39296 | 64586 | 30 | 35414 | 03882 | 5 | 96118 | 8 |
| 53 | 48 56 | 11 4 | 60732 | 26 | 39268 | 64620 | 31 | 35380 | 03888 | 5 | 96112 | 7 |
| 54 | 48 48 | 11 12 | 60761 | 26 | 39239 | 64654 | 31 | 35346 | 03893 | 5 | 96107 | 6 |
| 55 | 8 48 40 | 3 11 20 | 9. 60789 | 27 | 10. 39211 | 9. 64688 | 32 | 10. 35312 | 10. 03899 | 5 | 9. 96101 | 5 |
| 56 | 48 32 | 11 28 | 60818 | 27 | 39182 | 64722 | 32 | 35278 | 03905 | 5 | 96095 | 4 |
| 57 | 48 24 | 11 36 | 60846 | 28 | 39154 | 64756 | 33 | 35244 | 03910 | 5 | 96090 | 3 |
| 58 | 48 16 | 11 44 | 60875 | 28 | 39125 | 64790 | 33 | 35210 | 03916 | 5 | 96084 | 2 |
| 59 | 48 8 | 11 52 | 60903 | 29 | 39097 | 64824 | 34 | 35176 | 03921 | 5 | 96079 | 1 |
| 60 | 48 0 | 12 0 | 60931 | 29 | 39069 | 64858 | 35 | 35142 | 03927 | 6 | 96073 | 0 |

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SINES, TANGENTS, AND SECANTS.

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135°

| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 8 48 0 | 3 12 0 | 9. 60931 | 0 | 10. 39069 | 9. 64858 | 0 | 10. 35142 | 10. 03927 | 0 | 9. 96073 | 60 |
| 1 | 47 52 | 12 8 | 60960 | 0 | 39040 | 64892 | 1 | 35108 | 03933 | 0 | 96067 | 59 |
| 2 | 47 44 | 12 16 | 60988 | 1 | 39012 | 64926 | 1 | 35074 | 03938 | 0 | 96062 | 58 |
| 3 | 47 36 | 12 24 | 61016 | 1 | 38984 | 64960 | 2 | 35040 | 03944 | 0 | 96056 | 57 |
| 4 | 47 28 | 12 32 | 61045 | 2 | 38955 | 64994 | 2 | 35006 | 03950 | 0 | 96050 | 56 |
| 5 | 8 47 20 | 3 12 40 | 9. 61073 | 2 | 10. 38927 | 9. 65028 | 3 | 10. 34972 | 10. 03955 | 0 | 9. 96045 | 55 |
| 6 | 47 12 | 12 48 | 61101 | 3 | 38899 | 65062 | 3 | 34938 | 03961 | 1 | 96039 | 54 |
| 7 | 47 4 | 12 56 | 61129 | 3 | 38871 | 65096 | 4 | 34904 | 03966 | 1 | 96034 | 53 |
| 8 | 46 56 | 13 4 | 61158 | 4 | 38842 | 65130 | 4 | 34870 | 03972 | 1 | 96028 | 52 |
| 9 | 46 48 | 13 12 | 61186 | 4 | 38814 | 65164 | 5 | 34836 | 03978 | 1 | 96022 | 51 |
| 10 | 8 46 40 | 3 13 20 | 9. 61214 | 5 | 10. 38786 | 9. 65197 | 6 | 10. 34803 | 10. 03983 | 1 | 9. 96017 | 50 |
| 11 | 46 32 | 13 28 | 61242 | 5 | 38758 | 65231 | 6 | 34769 | 03989 | 1 | 96011 | 49 |
| 12 | 46 24 | 13 36 | 61270 | 6 | 38730 | 65265 | 7 | 34735 | 03995 | 1 | 96005 | 48 |
| 13 | 46 16 | 13 44 | 61298 | 6 | 38702 | 65299 | 7 | 34701 | 04000 | 1 | 96000 | 47 |
| 14 | 46 8 | 13 52 | 61326 | 6 | 38674 | 65333 | 8 | 34667 | 04006 | 1 | 95994 | 46 |
| 15 | 8 46 0 | 3 14 0 | 9. 61354 | 7 | 10. 38646 | 9. 65366 | 8 | 10. 34634 | 10. 04012 | 1 | 9. 95988 | 45 |
| 16 | 45 52 | 14 8 | 61382 | 7 | 38618 | 65400 | 9 | 34600 | 04018 | 2 | 95982 | 44 |
| 17 | 45 44 | 14 16 | 61411 | 8 | 38589 | 65434 | 9 | 34566 | 04023 | 2 | 95977 | 43 |
| 18 | 45 36 | 14 24 | 61438 | 8 | 38562 | 65467 | 10 | 34533 | 04029 | 2 | 95971 | 42 |
| 19 | 45 28 | 14 32 | 61466 | 9 | 38534 | 65501 | 11 | 34499 | 04035 | 2 | 95965 | 41 |
| 20 | 8 45 20 | 3 14 40 | 9. 61494 | 9 | 10. 38506 | 9. 65535 | 11 | 10. 34465 | 10. 04040 | 2 | 9. 95960 | 40 |
| 21 | 45 12 | 14 48 | 61522 | 10 | 38478 | 65568 | 12 | 34432 | 04046 | 2 | 95954 | 39 |
| 22 | 45 4 | 14 56 | 61550 | 10 | 38450 | 65602 | 12 | 34398 | 04052 | 2 | 95948 | 38 |
| 23 | 44 56 | 15 4 | 61578 | 11 | 38422 | 65636 | 13 | 34364 | 04058 | 2 | 95942 | 37 |
| 24 | 44 48 | 15 12 | 61606 | 11 | 38394 | 65669 | 13 | 34331 | 04063 | 2 | 95937 | 36 |
| 25 | 8 44 40 | 3 15 20 | 9. 61634 | 12 | 10. 38366 | 9. 65703 | 14 | 10. 34297 | 10. 04069 | 2 | 9. 95931 | 35 |
| 26 | 44 32 | 15 28 | 61662 | 12 | 38338 | 65736 | 15 | 34264 | 04075 | 2 | 95925 | 34 |
| 27 | 44 24 | 15 36 | 61689 | 12 | 38311 | 65770 | 15 | 34230 | 04080 | 3 | 95920 | 33 |
| 28 | 44 16 | 15 44 | 61717 | 13 | 38283 | 65803 | 16 | 34197 | 04086 | 3 | 95914 | 32 |
| 29 | 44 8 | 15 52 | 61745 | 13 | 38255 | 65837 | 16 | 34163 | 04092 | 3 | 95908 | 31 |
| 30 | 8 44 0 | 3 16 0 | 9. 61773 | 14 | 10. 38227 | 9. 65870 | 17 | 10. 34130 | 10. 04098 | 3 | 9. 95902 | 30 |
| 31 | 43 52 | 16 8 | 61800 | 14 | 38200 | 65904 | 17 | 34096 | 04103 | 3 | 95897 | 29 |
| 32 | 43 44 | 16 16 | 61828 | 15 | 38172 | 65937 | 18 | 34063 | 04109 | 3 | 95891 | 28 |
| 33 | 43 36 | 16 24 | 61856 | 15 | 38144 | 65971 | 18 | 34029 | 04115 | 3 | 95885 | 27 |
| 34 | 43 28 | 16 32 | 61883 | 16 | 38117 | 66004 | 19 | 33996 | 04121 | 3 | 95879 | 26 |
| 35 | 8 43 20 | 3 16 40 | 9. 61911 | 16 | 10. 38089 | 9. 66038 | 20 | 10. 33962 | 10. 04127 | 3 | 9. 95873 | 25 |
| 36 | 43 12 | 16 48 | 61939 | 17 | 38061 | 66071 | 20 | 33929 | 04132 | 3 | 95868 | 24 |
| 37 | 43 4 | 16 56 | 61966 | 17 | 38034 | 66104 | 21 | 33896 | 04138 | 4 | 95862 | 23 |
| 38 | 42 56 | 17 4 | 61994 | 18 | 38006 | 66138 | 21 | 33862 | 04144 | 4 | 95856 | 22 |
| 39 | 42 48 | 17 12 | 62021 | 18 | 37979 | 66171 | 22 | 33829 | 04150 | 4 | 95850 | 21 |
| 40 | 8 42 40 | 3 17 20 | 9. 62049 | 18 | 10. 37951 | 9. 66204 | 22 | 10. 33796 | 10. 04156 | 4 | 9. 95844 | 20 |
| 41 | 42 32 | 17 28 | 62076 | 19 | 37924 | 66237 | 23 | 33762 | 04161 | 4 | 95839 | 19 |
| 42 | 42 24 | 17 36 | 62104 | 19 | 37896 | 66271 | 23 | 33729 | 04167 | 4 | 95833 | 18 |
| 43 | 42 16 | 17 44 | 62131 | 20 | 37869 | 66304 | 24 | 33696 | 04173 | 4 | 95827 | 17 |
| 44 | 42 8 | 17 52 | 62159 | 20 | 37841 | 66337 | 25 | 33663 | 04179 | 4 | 95821 | 16 |
| 45 | 8 42 0 | 3 18 0 | 9. 62186 | 21 | 10. 37814 | 9. 66371 | 25 | 10. 33629 | 10. 04185 | 4 | 9. 95815 | 15 |
| 46 | 41 52 | 18 8 | 62214 | 21 | 37786 | 66404 | 26 | 33596 | 04190 | 4 | 95810 | 14 |
| 47 | 41 44 | 18 16 | 62241 | 22 | 37759 | 66437 | 26 | 33563 | 04196 | 5 | 95804 | 13 |
| 48 | 41 36 | 18 24 | 62268 | 22 | 37732 | 66470 | 27 | 33530 | 04202 | 5 | 95798 | 12 |
| 49 | 41 28 | 18 32 | 62296 | 23 | 37704 | 66503 | 27 | 33497 | 04208 | 5 | 95792 | 11 |
| 50 | 8 41 20 | 3 18 40 | 9. 62323 | 23 | 10. 37677 | 9. 66537 | 28 | 10. 33463 | 10. 04214 | 5 | 9. 95786 | 10 |
| 51 | 41 12 | 18 48 | 62350 | 24 | 37650 | 66570 | 28 | 33430 | 04220 | 5 | 95780 | 9 |
| 52 | 41 4 | 18 56 | 62377 | 24 | 37623 | 66603 | 29 | 33397 | 04225 | 5 | 95775 | 8 |
| 53 | 40 56 | 19 4 | 62405 | 24 | 37595 | 66636 | 30 | 33364 | 04231 | 5 | 95769 | 7 |
| 54 | 40 48 | 19 12 | 62432 | 25 | 37568 | 66669 | 30 | 33331 | 04237 | 5 | 95763 | 6 |
| 55 | 8 40 40 | 3 19 2 | 9. 62459 | 25 | 10. 37541 | 9. 66702 | 31 | 10. 33298 | 10. 04243 | 5 | 9. 95757 | 5 |
| 56 | 40 32 | 19 28 | 62486 | 26 | 37514 | 66735 | 31 | 33265 | 04249 | 5 | 95751 | 4 |
| 57 | 40 24 | 19 36 | 62513 | 26 | 37487 | 66768 | 32 | 33232 | 04255 | 5 | 95745 | 3 |
| 58 | 40 16 | 19 44 | 62541 | 27 | 37459 | 66801 | 32 | 33199 | 04261 | 6 | 95739 | 2 |
| 59 | 40 8 | 19 52 | 62568 | 27 | 37432 | 66834 | 33 | 33166 | 04267 | 6 | 95733 | 1 |
| 60 | 40 0 | 20 0 | 62595 | 28 | 37405 | 66867 | 33 | 33133 | 04272 | 6 | 95728 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 8 40 0 | 3 20 0 | 9.62595 | 0 | 10.37405 | 9.66867 | 0 | 10.33133 | 10.04272 | 0 | 9.95728 | 60 |
| 1 | 39 52 | 20 8 | 62622 | 0 | 37378 | 66900 | 1 | 33100 | 04278 | 0 | 95722 | 59 |
| 2 | 39 44 | 20 16 | 62649 | 1 | 37351 | 66933 | 1 | 33067 | 04284 | 0 | 95716 | 58 |
| 3 | 39 36 | 20 24 | 62676 | 1 | 37324 | 66966 | 2 | 33034 | 04290 | 0 | 95710 | 57 |
| 4 | 39 28 | 20 32 | 62703 | 2 | 37297 | 66999 | 2 | 33001 | 04296 | 0 | 95704 | 56 |
| 5 | 8 39 20 | 3 20 40 | 9.62730 | 2 | 10.37270 | 9.67032 | 3 | 10.32968 | 10.04302 | 1 | 9.95698 | 55 |
| 6 | 39 12 | 20 48 | 62757 | 3 | 37243 | 67065 | 3 | 32935 | 04308 | 1 | 95692 | 54 |
| 7 | 39 4 | 20 56 | 62784 | 3 | 37216 | 67098 | 4 | 32902 | 04314 | 1 | 95686 | 53 |
| 8 | 38 56 | 21 4 | 62811 | 4 | 37189 | 67131 | 4 | 32869 | 04320 | 1 | 95680 | 52 |
| 9 | 38 48 | 21 12 | 62838 | 4 | 37162 | 67163 | 5 | 32837 | 04326 | 1 | 95674 | 51 |
| 10 | 8 38 40 | 3 21 20 | 9.62865 | 4 | 10.37135 | 9.67196 | 5 | 10.32804 | 10.04332 | 1 | 9.95668 | 50 |
| 11 | 38 32 | 21 28 | 62892 | 5 | 37108 | 67229 | 6 | 32771 | 04337 | 1 | 95663 | 49 |
| 12 | 38 24 | 21 36 | 62918 | 5 | 37082 | 67262 | 7 | 32738 | 04343 | 1 | 95657 | 48 |
| 13 | 38 16 | 21 44 | 62945 | 6 | 37055 | 67295 | 7 | 32705 | 04349 | 1 | 95651 | 47 |
| 14 | 38 8 | 21 52 | 62972 | 6 | 37028 | 67327 | 8 | 32673 | 04355 | 1 | 95645 | 46 |
| 15 | 8 38 0 | 3 22 0 | 9.62999 | 7 | 10.37001 | 9.67300 | 8 | 10.32604 | 10.04361 | 2 | 9.95639 | 45 |
| 16 | 37 52 | 22 8 | 63026 | 7 | 36974 | 67393 | 9 | 32607 | 04367 | 2 | 95633 | 44 |
| 17 | 37 44 | 22 16 | 63052 | 8 | 36948 | 67426 | 9 | 32574 | 04373 | 2 | 95627 | 43 |
| 18 | 37 36 | 22 24 | 63079 | 8 | 36921 | 67458 | 10 | 32542 | 04379 | 2 | 95621 | 42 |
| 19 | 37 28 | 22 32 | 63106 | 8 | 36894 | 67491 | 10 | 32509 | 04385 | 2 | 95615 | 41 |
| 20 | 8 37 20 | 3 22 40 | 9.63133 | 9 | 10.36867 | 9.67524 | 11 | 10.32476 | 10.04391 | 2 | 9.95609 | 40 |
| 21 | 37 12 | 22 48 | 63159 | 9 | 36841 | 67556 | 11 | 32444 | 04397 | 2 | 95603 | 39 |
| 22 | 37 4 | 22 56 | 63186 | 10 | 36814 | 67589 | 12 | 32411 | 04403 | 2 | 95597 | 38 |
| 23 | 36 56 | 23 4 | 63213 | 10 | 36787 | 67622 | 12 | 32378 | 04409 | 2 | 95591 | 37 |
| 24 | 36 48 | 23 12 | 63239 | 11 | 36761 | 67654 | 13 | 32346 | 04415 | 2 | 95585 | 36 |
| 25 | 8 36 40 | 3 23 20 | 9.63266 | 11 | 10.36734 | 9.67687 | 14 | 10.32313 | 10.04421 | 3 | 9.95579 | 35 |
| 26 | 36 32 | 23 28 | 63292 | 11 | 36708 | 67719 | 14 | 32281 | 04427 | 3 | 95573 | 34 |
| 27 | 36 24 | 23 36 | 63319 | 12 | 36681 | 67752 | 15 | 32248 | 04433 | 3 | 95567 | 33 |
| 28 | 36 16 | 23 44 | 63345 | 12 | 36655 | 67785 | 15 | 32215 | 04439 | 3 | 95561 | 32 |
| 29 | 36 8 | 23 52 | 63372 | 13 | 36628 | 67817 | 16 | 32183 | 04445 | 3 | 95555 | 31 |
| 30 | 8 36 0 | 3 24 0 | 9.63398 | 13 | 10.36602 | 9.67850 | 16 | 10.32150 | 10.04451 | 3 | 9.95549 | 30 |
| 31 | 35 52 | 24 8 | 63425 | 14 | 36575 | 67882 | 17 | 32118 | 04457 | 3 | 95543 | 29 |
| 32 | 35 44 | 24 16 | 63451 | 14 | 36549 | 67915 | 17 | 32085 | 04463 | 3 | 95537 | 28 |
| 33 | 35 36 | 24 24 | 63478 | 15 | 36522 | 67947 | 18 | 32053 | 04469 | 3 | 95531 | 27 |
| 34 | 35 28 | 24 32 | 63504 | 15 | 36496 | 67980 | 18 | 32020 | 04475 | 3 | 95525 | 26 |
| 35 | 8 35 20 | 3 24 40 | 9.63531 | 15 | 10.36469 | 9.68012 | 19 | 10.31988 | 10.04481 | 4 | 9.95519 | 25 |
| 36 | 35 12 | 24 48 | 63557 | 16 | 36443 | 68044 | 20 | 31956 | 04487 | 4 | 95513 | 24 |
| 37 | 35 4 | 24 56 | 63583 | 16 | 36417 | 68077 | 20 | 31923 | 04493 | 4 | 95507 | 23 |
| 38 | 34 56 | 25 4 | 63610 | 17 | 36390 | 68109 | 21 | 31891 | 04500 | 4 | 95500 | 22 |
| 39 | 34 48 | 25 12 | 63636 | 17 | 36364 | 68142 | 21 | 31858 | 04506 | 4 | 95494 | 21 |
| 40 | 8 34 40 | 3 25 20 | 9.63662 | 18 | 10.36338 | 9.68174 | 22 | 10.31826 | 10.04512 | 4 | 9.95488 | 20 |
| 41 | 34 32 | 25 28 | 63689 | 18 | 36311 | 68206 | 22 | 31794 | 04518 | 4 | 95482 | 19 |
| 42 | 34 24 | 25 36 | 63715 | 19 | 36285 | 68239 | 23 | 31761 | 04524 | 4 | 95476 | 18 |
| 43 | 34 16 | 25 44 | 63741 | 19 | 36259 | 68271 | 23 | 31729 | 04530 | 4 | 95470 | 17 |
| 44 | 34 8 | 25 52 | 63767 | 19 | 36233 | 68303 | 24 | 31697 | 04536 | 4 | 95464 | 16 |
| 45 | 8 34 0 | 3 26 0 | 9.63794 | 20 | 10.36206 | 9.68336 | 24 | 10.31664 | 10.04542 | 5 | 9.95458 | 15 |
| 46 | 33 52 | 26 8 | 63820 | 20 | 36180 | 68368 | 25 | 31632 | 04548 | 5 | 95452 | 14 |
| 47 | 33 44 | 26 16 | 63846 | 21 | 36154 | 68400 | 25 | 31600 | 04554 | 5 | 95446 | 13 |
| 48 | 33 36 | 26 24 | 63872 | 21 | 36128 | 68432 | 26 | 31568 | 04560 | 5 | 95440 | 12 |
| 49 | 33 28 | 26 32 | 63898 | 22 | 36102 | 68465 | 27 | 31535 | 04566 | 5 | 95434 | 11 |
| 50 | 8 33 20 | 3 26 40 | 9.63924 | 22 | 10.36076 | 9.68497 | 27 | 10.31503 | 10.04573 | 5 | 9.95427 | 10 |
| 51 | 33 12 | 26 48 | 63950 | 23 | 36050 | 68529 | 28 | 31471 | 04579 | 5 | 95421 | 9 |
| 52 | 33 4 | 26 56 | 63976 | 23 | 36024 | 68561 | 28 | 31439 | 04585 | 5 | 95415 | 8 |
| 53 | 32 56 | 27 4 | 64002 | 23 | 35998 | 68593 | 29 | 31407 | 04591 | 5 | 95409 | 7 |
| 54 | 32 48 | 27 12 | 64028 | 24 | 35972 | 68626 | 29 | 31374 | 04597 | 5 | 95403 | 6 |
| 55 | 8 32 40 | 3 27 20 | 9.64054 | 24 | 10.35946 | 9.68658 | 30 | 10.31342 | 10.04603 | 6 | 9.95397 | 5 |
| 56 | 32 32 | 27 28 | 64080 | 25 | 35920 | 68690 | 30 | 31310 | 04609 | 6 | 95391 | 4 |
| 57 | 32 24 | 27 36 | 64106 | 25 | 35894 | 68722 | 31 | 31278 | 04616 | 6 | 95384 | 3 |
| 58 | 32 16 | 27 44 | 64132 | 26 | 35868 | 68754 | 31 | 31246 | 04622 | 6 | 95378 | 2 |
| 59 | 32 8 | 27 52 | 64158 | 26 | 35842 | 68786 | 32 | 31214 | 04628 | 6 | 95372 | 1 |
| 60 | 32 0 | 28 0 | 64184 | 26 | 35816 | 68818 | 33 | 31182 | 04634 | 6 | 95366 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 8 32 0 | 3 28 0 | 9. 64184 | 0 | 10. 35816 | 9. 68818 | 0 | 10. 31182 | 10. 04634 | 0 | 9. 95366 | 60 |
| 1 | 31 52 | 28 8 | 64210 | 0 | 35790 | 68850 | 1 | 31150 | 04640 | 0 | 95360 | 59 |
| 2 | 31 44 | 28 16 | 64236 | 1 | 35764 | 68882 | 1 | 31118 | 04646 | 0 | 95354 | 58 |
| 3 | 31 36 | 28 24 | 64262 | 1 | 35738 | 68914 | 2 | 31086 | 04652 | 0 | 95348 | 57 |
| 4 | 31 28 | 28 32 | 64288 | 2 | 35712 | 68946 | 2 | 31054 | 04659 | 0 | 95341 | 56 |
| 5 | 8 31 20 | 3 28 40 | 9. 64313 | 2 | 10. 35687 | 9. 68978 | 3 | 10. 31022 | 10. 04665 | 1 | 9. 95335 | 55 |
| 6 | 31 12 | 28 48 | 64339 | 3 | 35661 | 69010 | 3 | 30990 | 04671 | 1 | 95329 | 54 |
| 7 | 31 4 | 28 56 | 64365 | 3 | 35635 | 69042 | 4 | 30958 | 04677 | 1 | 95323 | 53 |
| 8 | 30 56 | 29 4 | 64391 | 3 | 35609 | 69074 | 4 | 30926 | 04683 | 1 | 95317 | 52 |
| 9 | 30 48 | 29 12 | 64417 | 4 | 35583 | 69106 | 5 | 30894 | 04690 | 1 | 95310 | 51 |
| 10 | 8 30 40 | 3 29 20 | 9. 64442 | 4 | 10. 35558 | 9. 69138 | 5 | 10. 30862 | 10. 04696 | 1 | 9. 95304 | 50 |
| 11 | 30 32 | 29 28 | 64468 | 5 | 35532 | 69170 | 6 | 30830 | 04702 | 1 | 95298 | 49 |
| 12 | 30 24 | 29 36 | 64494 | 5 | 35506 | 69202 | 6 | 30798 | 04708 | 1 | 95292 | 48 |
| 13 | 30 16 | 29 44 | 64519 | 5 | 35481 | 69234 | 7 | 30766 | 04714 | 1 | 95286 | 47 |
| 14 | 30 8 | 29 52 | 64545 | 6 | 35455 | 69266 | 7 | 30734 | 04721 | 1 | 95279 | 46 |
| 15 | 8 30 0 | 3 30 0 | 9. 64571 | 6 | 10. 35429 | 9. 69298 | 8 | 10. 30702 | 10. 04727 | 2 | 9. 95273 | 45 |
| 16 | 29 52 | 30 8 | 64596 | 7 | 35404 | 69329 | 8 | 30671 | 04733 | 2 | 95267 | 44 |
| 17 | 29 44 | 30 16 | 64622 | 7 | 35378 | 69361 | 9 | 30639 | 04739 | 2 | 95261 | 43 |
| 18 | 29 36 | 30 24 | 64647 | 8 | 35353 | 69393 | 9 | 30607 | 04746 | 2 | 95254 | 42 |
| 19 | 29 28 | 30 32 | 64673 | 8 | 35327 | 69425 | 10 | 30575 | 04752 | 2 | 95248 | 41 |
| 20 | 8 29 20 | 3 30 40 | 9. 64698 | 8 | 10. 35302 | 9. 69457 | 11 | 10. 30543 | 10. 04758 | 2 | 9. 95242 | 40 |
| 21 | 29 12 | 30 48 | 64724 | 9 | 35276 | 69488 | 11 | 30512 | 04764 | 2 | 95236 | 39 |
| 22 | 29 4 | 30 56 | 64749 | 9 | 35251 | 69520 | 12 | 30480 | 04771 | 2 | 95229 | 38 |
| 23 | 28 56 | 31 4 | 64775 | 10 | 35225 | 69552 | 12 | 30448 | 04777 | 2 | 95223 | 37 |
| 24 | 28 48 | 31 12 | 64800 | 10 | 35200 | 69584 | 13 | 30416 | 04783 | 3 | 95217 | 36 |
| 25 | 8 28 40 | 3 31 20 | 9. 64826 | 11 | 10. 35174 | 9. 69615 | 13 | 10. 30385 | 10. 04789 | 3 | 9. 95211 | 35 |
| 26 | 28 32 | 31 28 | 64851 | 11 | 35149 | 69647 | 14 | 30353 | 04796 | 3 | 95204 | 34 |
| 27 | 28 24 | 31 36 | 64877 | 11 | 35123 | 69679 | 14 | 30321 | 04802 | 3 | 95198 | 33 |
| 28 | 28 16 | 31 44 | 64902 | 12 | 35098 | 69710 | 15 | 30290 | 04808 | 3 | 95192 | 32 |
| 29 | 28 8 | 31 52 | 64927 | 12 | 35073 | 69742 | 15 | 30258 | 04815 | 3 | 95185 | 31 |
| 30 | 8 28 0 | 3 32 0 | 9. 64953 | 13 | 10. 35047 | 9. 69774 | 16 | 10. 30226 | 10. 04821 | 3 | 9. 95179 | 30 |
| 31 | 27 52 | 32 8 | 64978 | 13 | 35022 | 69805 | 16 | 30195 | 04827 | 3 | 95173 | 29 |
| 32 | 27 44 | 32 16 | 65003 | 14 | 34997 | 69837 | 17 | 30163 | 04833 | 3 | 95167 | 28 |
| 33 | 27 36 | 32 24 | 65029 | 14 | 34971 | 69868 | 17 | 30132 | 04840 | 3 | 95160 | 27 |
| 34 | 27 28 | 32 32 | 65054 | 14 | 34946 | 69900 | 18 | 30100 | 04846 | 4 | 95154 | 26 |
| 35 | 8 27 20 | 3 32 40 | 9. 65079 | 15 | 10. 34921 | 9. 69932 | 18 | 10. 30068 | 10. 04852 | 4 | 9. 95148 | 25 |
| 36 | 27 12 | 32 48 | 65104 | 15 | 34896 | 69963 | 19 | 30037 | 04859 | 4 | 95141 | 24 |
| 37 | 27 4 | 32 56 | 65130 | 16 | 34870 | 69995 | 20 | 30005 | 04865 | 4 | 95135 | 23 |
| 38 | 26 56 | 33 4 | 65155 | 16 | 34845 | 70026 | 20 | 29974 | 04871 | 4 | 95129 | 22 |
| 39 | 26 48 | 33 12 | 65180 | 16 | 34820 | 70058 | 21 | 29942 | 04878 | 4 | 95122 | 21 |
| 40 | 8 26 40 | 3 33 20 | 9. 65205 | 17 | 10. 34795 | 9. 70089 | 21 | 10. 29911 | 10. 04884 | 4 | 9. 95116 | 20 |
| 41 | 26 32 | 33 28 | 65230 | 17 | 34770 | 70121 | 22 | 29879 | 04890 | 4 | 95110 | 19 |
| 42 | 26 24 | 33 36 | 65255 | 18 | 34745 | 70152 | 22 | 29848 | 04897 | 4 | 95103 | 18 |
| 43 | 26 16 | 33 44 | 65281 | 18 | 34719 | 70184 | 23 | 29816 | 04903 | 5 | 95097 | 17 |
| 44 | 26 8 | 33 52 | 65306 | 19 | 34694 | 70215 | 23 | 29785 | 04910 | 5 | 95090 | 16 |
| 45 | 8 26 0 | 3 34 0 | 9. 65331 | 19 | 10. 34669 | 9. 70247 | 24 | 10. 29753 | 10. 04916 | 5 | 9. 95084 | 15 |
| 46 | 25 52 | 34 8 | 65356 | 19 | 34644 | 70278 | 24 | 29722 | 04922 | 5 | 95078 | 14 |
| 47 | 25 44 | 34 16 | 65381 | 20 | 34619 | 70309 | 25 | 29691 | 04929 | 5 | 95071 | 13 |
| 48 | 25 36 | 34 24 | 65406 | 20 | 34594 | 70341 | 25 | 29659 | 04935 | 5 | 95065 | 12 |
| 49 | 25 28 | 34 32 | 65431 | 21 | 34569 | 70372 | 26 | 29628 | 04941 | 5 | 95059 | 11 |
| 50 | 8 25 20 | 3 34 40 | 9. 65456 | 21 | 10. 34544 | 9. 70404 | 26 | 10. 29596 | 10. 04948 | 5 | 9. 95052 | 10 |
| 51 | 25 12 | 34 48 | 65481 | 22 | 34519 | 70435 | 27 | 29565 | 04954 | 5 | 95046 | 9 |
| 52 | 25 4 | 34 56 | 65506 | 22 | 34494 | 70466 | 27 | 29534 | 04961 | 5 | 95039 | 8 |
| 53 | 24 56 | 35 4 | 65531 | 22 | 34469 | 70498 | 28 | 29502 | 04967 | 6 | 95033 | 7 |
| 54 | 24 48 | 35 12 | 65556 | 23 | 34444 | 70529 | 28 | 29471 | 04973 | 6 | 95027 | 6 |
| 55 | 8 24 40 | 3 35 20 | 9. 65580 | 23 | 10. 34420 | 9. 70560 | 29 | 10. 29440 | 10. 04980 | 6 | 9. 95020 | 5 |
| 56 | 24 32 | 35 28 | 65605 | 24 | 34395 | 70592 | 30 | 29408 | 04986 | 6 | 95014 | 4 |
| 57 | 24 24 | 35 36 | 65630 | 24 | 34370 | 70623 | 30 | 29377 | 04993 | 6 | 95007 | 3 |
| 58 | 24 16 | 35 44 | 65655 | 25 | 34345 | 70654 | 31 | 29346 | 04999 | 6 | 95001 | 2 |
| 59 | 24 8 | 35 52 | 65680 | 25 | 34320 | 70685 | 31 | 29315 | 05005 | 6 | 94995 | 1 |
| 60 | 24 0 | 36 0 | 65705 | 25 | 34295 | 70717 | 32 | 29283 | 05012 | 6 | 94988 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|----------|-------|------------|-----------|-------|----------|----|
| 0 | 8 24 0 | 3 36 0 | 9. 65705 | 0 | 10. 34295 | 9. 70717 | 0 | 10. 29283 | 10. 05012 | 0 | 9. 94988 | 60 |
| 1 | 23 52 | 36 8 | 65729 | 0 | 34271 | 70748 | 1 | 29252 | 05018 | 0 | 94982 | 59 |
| 2 | 23 44 | 36 16 | 65754 | 1 | 34246 | 70779 | 1 | 29221 | 05025 | 0 | 94975 | 58 |
| 3 | 23 36 | 36 24 | 65779 | 1 | 34221 | 70810 | 2 | 29190 | 05031 | 0 | 94969 | 57 |
| 4 | 23 28 | 36 32 | 65804 | 2 | 34196 | 70841 | 2 | 29159 | 05038 | 0 | 94962 | 56 |
| 5 | 8 23 20 | 3 36 40 | 9. 65828 | 2 | 10. 34172 | 9. 70873 | 3 | 10. 29127 | 10. 05044 | 1 | 9. 94956 | 55 |
| 6 | 23 12 | 36 48 | 65853 | 2 | 34147 | 70904 | 3 | 29096 | 05051 | 1 | 94949 | 54 |
| 7 | 23 4 | 36 56 | 65878 | 3 | 34122 | 70935 | 4 | 29065 | 05057 | 1 | 94943 | 53 |
| 8 | 22 56 | 37 4 | 65902 | 3 | 34098 | 70966 | 4 | 29034 | 05064 | 1 | 94936 | 52 |
| 9 | 22 48 | 37 12 | 65927 | 4 | 34073 | 70997 | 5 | 29003 | 05070 | 1 | 94930 | 51 |
| 10 | 8 22 40 | 3 37 20 | 9. 65952 | 4 | 10. 34048 | 9. 71028 | 5 | 10. 28972 | 10. 05077 | 1 | 9. 94923 | 50 |
| 11 | 22 32 | 37 28 | 65976 | 4 | 34024 | 71059 | 6 | 28941 | 05083 | 1 | 94917 | 49 |
| 12 | 22 24 | 37 36 | 66001 | 5 | 33999 | 71090 | 6 | 28910 | 05089 | 1 | 94911 | 48 |
| 13 | 22 16 | 37 44 | 66025 | 5 | 33975 | 71121 | 7 | 28879 | 05096 | 1 | 94904 | 47 |
| 14 | 22 8 | 37 52 | 66050 | 6 | 33950 | 71153 | 7 | 28847 | 05102 | 2 | 94898 | 46 |
| 15 | 8 22 0 | 3 38 0 | 9. 66075 | 6 | 10. 33925 | 9. 71184 | 8 | 10. 28816 | 10. 05109 | 2 | 9. 94891 | 45 |
| 16 | 21 52 | 38 8 | 66099 | 6 | 33901 | 71215 | 8 | 28785 | 05115 | 2 | 94885 | 44 |
| 17 | 21 44 | 38 16 | 66124 | 7 | 33876 | 71246 | 9 | 28754 | 05122 | 2 | 94878 | 43 |
| 18 | 21 36 | 38 24 | 66148 | 7 | 33852 | 71277 | 9 | 28723 | 05129 | 2 | 94871 | 42 |
| 19 | 21 28 | 38 32 | 66173 | 8 | 33827 | 71308 | 10 | 28692 | 05135 | 2 | 94865 | 41 |
| 20 | 8 21 20 | 3 38 40 | 9. 66197 | 8 | 10. 33803 | 9. 71339 | 10 | 10. 28661 | 10. 05142 | 2 | 9. 94858 | 40 |
| 21 | 21 12 | 38 48 | 66221 | 8 | 33779 | 71370 | 11 | 28630 | 05148 | 2 | 94852 | 39 |
| 22 | 21 4 | 38 56 | 66246 | 9 | 33754 | 71401 | 11 | 28599 | 05155 | 2 | 94845 | 38 |
| 23 | 20 56 | 39 4 | 66270 | 9 | 33730 | 71431 | 12 | 28569 | 05161 | 3 | 94839 | 37 |
| 24 | 20 48 | 39 12 | 66295 | 10 | 33705 | 71462 | 12 | 28538 | 05168 | 3 | 94832 | 36 |
| 25 | 8 20 40 | 3 39 20 | 9. 66319 | 10 | 10. 33681 | 9. 71493 | 13 | 10. 28507 | 10. 05174 | 3 | 9. 94826 | 35 |
| 26 | 20 32 | 39 28 | 66343 | 11 | 33657 | 71524 | 13 | 28476 | 05181 | 3 | 94819 | 34 |
| 27 | 20 24 | 39 36 | 66368 | 11 | 33632 | 71555 | 14 | 28445 | 05187 | 3 | 94813 | 33 |
| 28 | 20 16 | 39 44 | 66392 | 11 | 33608 | 71586 | 14 | 28414 | 05194 | 3 | 94806 | 32 |
| 29 | 20 8 | 39 52 | 66416 | 12 | 33584 | 71617 | 15 | 28383 | 05201 | 3 | 94799 | 31 |
| 30 | 8 20 0 | 3 40 0 | 9. 66441 | 12 | 10. 33559 | 9. 71648 | 15 | 10. 28352 | 10. 05207 | 3 | 9. 94793 | 30 |
| 31 | 19 52 | 40 8 | 66465 | 13 | 33535 | 71679 | 16 | 28321 | 05214 | 3 | 94786 | 29 |
| 32 | 19 44 | 40 16 | 66489 | 13 | 33511 | 71709 | 16 | 28291 | 05220 | 4 | 94780 | 28 |
| 33 | 19 36 | 40 24 | 66513 | 13 | 33487 | 71740 | 17 | 28260 | 05227 | 4 | 94773 | 27 |
| 34 | 19 28 | 40 32 | 66537 | 14 | 33463 | 71771 | 17 | 28229 | 05233 | 4 | 94767 | 26 |
| 35 | 8 19 20 | 3 40 40 | 9. 66562 | 14 | 10. 33438 | 9. 71802 | 18 | 10. 28198 | 10. 05240 | 4 | 9. 94760 | 25 |
| 36 | 19 12 | 40 48 | 66586 | 15 | 33414 | 71833 | 19 | 28167 | 00247 | 4 | 94753 | 24 |
| 37 | 19 4 | 40 56 | 66610 | 15 | 33390 | 71863 | 19 | 28137 | 05253 | 4 | 94747 | 23 |
| 38 | 18 56 | 41 4 | 66634 | 15 | 33366 | 71894 | 20 | 28106 | 05260 | 4 | 94740 | 22 |
| 39 | 18 48 | 41 12 | 66658 | 16 | 33342 | 71925 | 20 | 28075 | 05266 | 4 | 94734 | 21 |
| 40 | 8 18 40 | 3 41 20 | 9. 66682 | 16 | 10. 33318 | 9. 71955 | 21 | 10. 28045 | 10. 05273 | 4 | 9. 94727 | 20 |
| 41 | 18 32 | 41 28 | 66706 | 17 | 33294 | 71986 | 21 | 28014 | 05280 | 4 | 94720 | 19 |
| 42 | 18 24 | 41 36 | 66731 | 17 | 33269 | 72017 | 22 | 27983 | 05286 | 5 | 94714 | 18 |
| 43 | 18 16 | 41 44 | 66755 | 17 | 33245 | 72048 | 22 | 27952 | 05293 | 5 | 94707 | 17 |
| 44 | 18 8 | 41 52 | 66779 | 18 | 33221 | 72078 | 23 | 27922 | 05300 | 5 | 94700 | 16 |
| 45 | 8 18 0 | 3 42 0 | 9. 66803 | 18 | 10. 33197 | 9. 72109 | 23 | 10. 27891 | 10. 05306 | 5 | 9. 94694 | 15 |
| 46 | 17 52 | 42 8 | 66827 | 19 | 33173 | 72140 | 24 | 27860 | 05313 | 5 | 94687 | 14 |
| 47 | 17 44 | 42 16 | 66851 | 19 | 33149 | 72170 | 24 | 27830 | 05320 | 5 | 94680 | 13 |
| 48 | 17 36 | 42 24 | 66875 | 19 | 33125 | 72201 | 25 | 27799 | 05326 | 5 | 94674 | 12 |
| 49 | 17 28 | 42 32 | 66899 | 20 | 33101 | 72231 | 25 | 27769 | 05333 | 5 | 94667 | 11 |
| 50 | 8 17 20 | 3 42 40 | 9. 66922 | 20 | 10. 33078 | 9. 72262 | 26 | 10. 27738 | 10. 05340 | 5 | 9. 94660 | 10 |
| 51 | 17 12 | 42 48 | 66946 | 21 | 33054 | 72293 | 26 | 27707 | 05346 | 6 | 94654 | 9 |
| 52 | 17 4 | 42 56 | 66970 | 21 | 33030 | 72323 | 27 | 27677 | 05353 | 6 | 94647 | 8 |
| 53 | 16 56 | 43 4 | 66994 | 21 | 33006 | 72354 | 27 | 27646 | 05360 | 6 | 94640 | 7 |
| 54 | 16 48 | 43 12 | 67018 | 22 | 32982 | 72384 | 28 | 27616 | 05366 | 6 | 94634 | 6 |
| 55 | 8 16 40 | 3 43 20 | 9. 67042 | 22 | 10. 32958 | 9. 72415 | 28 | 10. 27585 | 10. 05373 | 6 | 9. 94627 | 5 |
| 56 | 16 32 | 43 28 | 67066 | 23 | 32934 | 72445 | 29 | 27555 | 05380 | 6 | 94620 | 4 |
| 57 | 16 24 | 43 36 | 67090 | 23 | 32910 | 72476 | 29 | 27524 | 05386 | 6 | 94614 | 3 |
| 58 | 16 16 | 43 44 | 67113 | 23 | 32887 | 72506 | 30 | 27494 | 05393 | 6 | 94607 | 2 |
| 59 | 16 8 | 43 52 | 67137 | 24 | 32863 | 72537 | 30 | 27463 | 05400 | 6 | 94600 | 1 |
| 60 | 16 0 | 44 0 | 67161 | 24 | 32839 | 72567 | 31 | 27433 | 05407 | 7 | 94593 | 0 |

| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|
|----|------------|------------|---------|-------|---------|------------|-------|----------|-----------|-------|-------|----|

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SINES, TANGENTS, AND SECANTS.

29°

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 8 16 0 | 3 44 0 | 9. 67161 | 0 | 10. 32839 | 9. 72567 | 0 | 10. 27433 | 10. 05407 | 0 | 9. 94593 | 60 |
| 1 | 15 52 | 44 8 | 67185 | 0 | 32815 | 72598 | 1 | 27402 | 05413 | 0 | 94587 | 59 |
| 2 | 15 44 | 44 16 | 67208 | 1 | 32792 | 72628 | 1 | 27372 | 05420 | 0 | 94580 | 58 |
| 3 | 15 36 | 44 24 | 67232 | 1 | 32768 | 72659 | 2 | 27341 | 05427 | 0 | 94573 | 57 |
| 4 | 15 28 | 44 32 | 67256 | 2 | 32744 | 72689 | 2 | 27311 | 05433 | 0 | 94567 | 56 |
| 5 | 8 15 20 | 3 44 40 | 9. 67280 | 2 | 10. 32720 | 9. 72720 | 3 | 10. 27280 | 10. 05440 | 1 | 9. 94560 | 55 |
| 6 | 15 12 | 44 48 | 67303 | 2 | 32697 | 72750 | 3 | 27250 | 05447 | 1 | 94553 | 54 |
| 7 | 15 4 | 44 56 | 67327 | 3 | 32673 | 72780 | 4 | 27220 | 05454 | 1 | 94546 | 53 |
| 8 | 14 56 | 45 4 | 67350 | 3 | 32650 | 72811 | 4 | 27189 | 05460 | 1 | 94540 | 52 |
| 9 | 14 48 | 45 12 | 67374 | 3 | 32626 | 72841 | 5 | 27159 | 05467 | 1 | 94533 | 51 |
| 10 | 8 14 40 | 3 45 20 | 9. 67398 | 4 | 10. 32602 | 9. 72872 | 5 | 10. 27128 | 10. 05474 | 1 | 9. 94526 | 50 |
| 11 | 14 32 | 45 28 | 67421 | 4 | 32579 | 72902 | 6 | 27098 | 05481 | 1 | 94519 | 49 |
| 12 | 14 24 | 45 36 | 67445 | 5 | 32555 | 72932 | 6 | 27068 | 05487 | 1 | 94513 | 48 |
| 13 | 14 16 | 45 44 | 67468 | 5 | 32532 | 72963 | 7 | 27037 | 05494 | 1 | 94506 | 47 |
| 14 | 14 8 | 45 52 | 67492 | 5 | 32508 | 72993 | 7 | 27007 | 05501 | 2 | 94499 | 46 |
| 15 | 8 14 0 | 3 46 0 | 9. 67515 | 6 | 10. 32485 | 9. 73023 | 8 | 10. 26977 | 10. 05508 | 2 | 9. 94492 | 45 |
| 16 | 13 52 | 46 8 | 67539 | 6 | 32461 | 73054 | 8 | 26946 | 05515 | 2 | 94485 | 44 |
| 17 | 13 44 | 46 16 | 67562 | 7 | 32438 | 73084 | 9 | 26916 | 05521 | 2 | 94479 | 43 |
| 18 | 13 36 | 46 24 | 67586 | 7 | 32414 | 73114 | 9 | 26886 | 05528 | 2 | 94472 | 42 |
| 19 | 13 28 | 46 32 | 67609 | 7 | 32391 | 73144 | 10 | 26856 | 05535 | 2 | 94465 | 41 |
| 20 | 8 13 20 | 3 46 40 | 9. 67633 | 8 | 10. 32367 | 9. 73175 | 10 | 10. 26825 | 10. 05542 | 2 | 9. 94458 | 40 |
| 21 | 13 12 | 46 48 | 67656 | 8 | 32344 | 73205 | 11 | 26795 | 05549 | 2 | 94451 | 39 |
| 22 | 13 4 | 46 56 | 67680 | 9 | 32320 | 73235 | 11 | 26765 | 05555 | 3 | 94445 | 38 |
| 23 | 12 56 | 47 4 | 67703 | 9 | 32297 | 73265 | 12 | 26735 | 05562 | 3 | 94438 | 37 |
| 24 | 12 48 | 47 12 | 67726 | 9 | 32274 | 73295 | 12 | 26705 | 05569 | 3 | 94431 | 36 |
| 25 | 8 12 40 | 3 47 20 | 9. 67750 | 10 | 10. 32250 | 9. 73326 | 13 | 10. 26674 | 10. 05576 | 3 | 9. 94424 | 35 |
| 26 | 12 32 | 47 28 | 67773 | 10 | 32227 | 73356 | 13 | 26644 | 05583 | 3 | 94417 | 34 |
| 27 | 12 24 | 47 36 | 67796 | 10 | 32204 | 73386 | 14 | 26614 | 05590 | 3 | 94410 | 33 |
| 28 | 12 16 | 47 44 | 67820 | 11 | 32180 | 73416 | 14 | 26584 | 05596 | 3 | 94404 | 32 |
| 29 | 12 8 | 47 52 | 67843 | 11 | 32157 | 73446 | 15 | 26554 | 05603 | 3 | 94397 | 31 |
| 30 | 8 12 0 | 3 48 0 | 9. 67866 | 12 | 10. 32134 | 9. 73476 | 15 | 10. 26524 | 10. 05610 | 3 | 9. 94390 | 30 |
| 31 | 11 52 | 48 8 | 67890 | 12 | 32110 | 73507 | 16 | 26493 | 05617 | 4 | 94383 | 29 |
| 32 | 11 44 | 48 16 | 67913 | 12 | 32087 | 73537 | 16 | 26463 | 05624 | 4 | 94376 | 28 |
| 33 | 11 36 | 48 24 | 67936 | 13 | 32064 | 73567 | 17 | 26433 | 05631 | 4 | 94369 | 27 |
| 34 | 11 28 | 48 32 | 67959 | 13 | 32041 | 73597 | 17 | 26403 | 05638 | 4 | 94362 | 26 |
| 35 | 8 11 20 | 3 48 40 | 9. 67982 | 14 | 10. 32018 | 9. 73627 | 18 | 10. 26373 | 10. 05645 | 4 | 9. 94355 | 25 |
| 36 | 11 12 | 48 48 | 68006 | 14 | 31994 | 73657 | 18 | 26343 | 05651 | 4 | 94349 | 24 |
| 37 | 11 4 | 48 56 | 68029 | 14 | 31971 | 73687 | 19 | 26313 | 05658 | 4 | 94342 | 23 |
| 38 | 10 56 | 49 4 | 68052 | 15 | 31948 | 73717 | 19 | 26283 | 05665 | 4 | 94335 | 22 |
| 39 | 10 48 | 49 12 | 68075 | 15 | 31925 | 73747 | 20 | 26253 | 05672 | 4 | 94328 | 21 |
| 40 | 8 10 40 | 3 49 20 | 9. 68098 | 16 | 10. 31902 | 9. 73777 | 20 | 10. 26223 | 10. 05679 | 5 | 9. 94321 | 20 |
| 41 | 10 32 | 49 28 | 68121 | 16 | 31879 | 73807 | 21 | 26193 | 05686 | 5 | 94314 | 19 |
| 42 | 10 24 | 49 36 | 68144 | 16 | 31856 | 73837 | 21 | 26163 | 05693 | 5 | 94307 | 18 |
| 43 | 10 16 | 49 44 | 68167 | 17 | 31833 | 73867 | 22 | 26133 | 05700 | 5 | 94300 | 17 |
| 44 | 10 8 | 49 52 | 68190 | 17 | 31810 | 73897 | 22 | 26103 | 05707 | 5 | 94293 | 16 |
| 45 | 8 10 0 | 3 50 0 | 9. 68213 | 17 | 10. 31787 | 9. 73927 | 23 | 10. 26073 | 10. 05714 | 5 | 9. 94286 | 15 |
| 46 | 9 52 | 50 8 | 68237 | 18 | 31763 | 73957 | 23 | 26043 | 05721 | 5 | 94279 | 14 |
| 47 | 9 44 | 50 16 | 68260 | 18 | 31740 | 73987 | 24 | 26013 | 05727 | 5 | 94273 | 13 |
| 48 | 9 36 | 50 24 | 68283 | 19 | 31717 | 74017 | 24 | 25983 | 05734 | 5 | 94266 | 12 |
| 49 | 9 28 | 50 32 | 68305 | 19 | 31695 | 74047 | 25 | 25953 | 05741 | 6 | 94259 | 11 |
| 50 | 8 9 20 | 3 50 40 | 9. 68328 | 20 | 10. 31672 | 9. 74077 | 25 | 10. 25923 | 10. 05748 | 6 | 9. 94252 | 10 |
| 51 | 9 12 | 50 48 | 68351 | 20 | 31649 | 74107 | 26 | 25893 | 05755 | 6 | 94245 | 9 |
| 52 | 9 4 | 50 56 | 68374 | 20 | 31626 | 74137 | 26 | 25863 | 05762 | 6 | 94238 | 8 |
| 53 | 8 56 | 51 4 | 68397 | 21 | 31603 | 74166 | 27 | 25834 | 05769 | 6 | 94231 | 7 |
| 54 | 8 48 | 51 12 | 68420 | 21 | 31580 | 74196 | 27 | 25804 | 05776 | 6 | 94224 | 6 |
| 55 | 8 8 40 | 3 51 20 | 9. 68443 | 21 | 10. 31557 | 9. 74226 | 28 | 10. 25774 | 10. 05783 | 6 | 9. 94217 | 5 |
| 56 | 8 32 | 51 28 | 68466 | 22 | 31534 | 74256 | 28 | 25744 | 05790 | 6 | 94210 | 4 |
| 57 | 8 24 | 51 36 | 68489 | 22 | 31511 | 74286 | 29 | 25714 | 05797 | 7 | 94203 | 3 |
| 58 | 8 16 | 51 44 | 68512 | 22 | 31488 | 74316 | 29 | 25684 | 05804 | 7 | 94196 | 2 |
| 59 | 8 8 | 51 52 | 68534 | 23 | 31466 | 74345 | 30 | 25655 | 05811 | 7 | 94189 | 1 |
| 60 | 8 0 | 52 0 | 68557 | 23 | 31443 | 74375 | 30 | 25625 | 05818 | 7 | 94182 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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150°

| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 8 0 | 3 52 0 | 9. 68557 | 0 | 10. 31443 | 9. 74375 | 0 | 10. 25625 | 10. 05818 | 0 | 9. 94182 | 60 |
| 1 | 7 52 | 52 8 | 68580 | 0 | 31420 | 74405 | 0 | 25595 | 05825 | 0 | 94175 | 59 |
| 2 | 7 44 | 52 16 | 68603 | 1 | 31397 | 74435 | 1 | 25565 | 05832 | 0 | 94168 | 58 |
| 3 | 7 36 | 52 24 | 68625 | 1 | 31375 | 74465 | 1 | 25535 | 05839 | 0 | 94161 | 57 |
| 4 | 7 28 | 52 32 | 68648 | 1 | 31352 | 74494 | 2 | 25506 | 05846 | 0 | 94154 | 56 |
| 5 | 8 7 20 | 3 52 40 | 9. 68671 | 2 | 10. 31329 | 9. 74524 | 2 | 10. 25476 | 10. 05853 | 1 | 9. 94147 | 55 |
| 6 | 7 12 | 52 48 | 68694 | 2 | 31306 | 74554 | 3 | 25446 | 05860 | 1 | 94140 | 54 |
| 7 | 7 4 | 52 56 | 68716 | 3 | 31284 | 74583 | 3 | 25417 | 05867 | 1 | 94133 | 53 |
| 8 | 6 56 | 53 4 | 68739 | 3 | 31261 | 74613 | 4 | 25387 | 05874 | 1 | 94126 | 52 |
| 9 | 6 48 | 53 12 | 68762 | 3 | 31238 | 74643 | 4 | 25357 | 05881 | 1 | 94119 | 51 |
| 10 | 8 6 40 | 3 53 20 | 9. 68784 | 4 | 10. 31216 | 9. 74673 | 5 | 10. 25327 | 10. 05888 | 1 | 9. 94112 | 50 |
| 11 | 6 32 | 53 28 | 68807 | 4 | 31193 | 74702 | 5 | 25298 | 05895 | 1 | 94105 | 49 |
| 12 | 6 24 | 53 36 | 68829 | 4 | 31171 | 74732 | 6 | 25268 | 05902 | 1 | 94098 | 48 |
| 13 | 6 16 | 53 44 | 68852 | 5 | 31148 | 74762 | 6 | 25238 | 05910 | 2 | 94090 | 47 |
| 14 | 6 8 | 53 52 | 68875 | 5 | 31125 | 74791 | 7 | 25209 | 05917 | 2 | 94083 | 46 |
| 15 | 8 6 0 | 3 54 0 | 9. 68897 | 6 | 10. 31103 | 9. 74821 | 7 | 10. 25179 | 10. 05924 | 2 | 9. 94076 | 45 |
| 16 | 5 52 | 54 8 | 68920 | 6 | 31080 | 74851 | 8 | 25149 | 05931 | 2 | 94069 | 44 |
| 17 | 5 44 | 54 16 | 68942 | 6 | 31058 | 74880 | 8 | 25120 | 05938 | 2 | 94062 | 43 |
| 18 | 5 36 | 54 24 | 68965 | 7 | 31035 | 74910 | 9 | 25090 | 05945 | 2 | 94055 | 42 |
| 19 | 5 28 | 54 32 | 68987 | 7 | 31013 | 74939 | 9 | 25061 | 05952 | -2 | 94048 | 41 |
| 20 | 8 5 20 | 3 54 40 | 9. 69010 | 7 | 10. 30990 | 9. 74969 | 10 | 10. 25031 | 10. 05959 | 2 | 9. 94041 | 40 |
| 21 | 5 12 | 54 48 | 69032 | 8 | 30968 | 74998 | 10 | 25002 | 05966 | 3 | 94034 | 39 |
| 22 | 5 4 | 54 56 | 69055 | 8 | 30945 | 75028 | 11 | 24972 | 05973 | 3 | 94027 | 38 |
| 23 | 4 56 | 55 4 | 69077 | 9 | 30923 | 75058 | 11 | 24942 | 05980 | 3 | 94020 | 37 |
| 24 | 4 48 | 55 12 | 69100 | 9 | 30900 | 75087 | 12 | 24913 | 05988 | 3 | 94012 | 36 |
| 25 | 8 4 40 | 3 55 20 | 9. 69122 | 9 | 10. 30878 | 9. 75117 | 12 | 10. 24883 | 10. 05995 | 3 | 9. 94005 | 35 |
| 26 | 4 32 | 55 28 | 69144 | 10 | 30856 | 75146 | 13 | 24854 | 06002 | 3 | 93998 | 34 |
| 27 | 4 24 | 55 36 | 69167 | 10 | 30833 | 75176 | 13 | 24824 | 06009 | 3 | 93991 | 33 |
| 28 | 4 16 | 55 44 | 69189 | 10 | 30811 | 75205 | 14 | 24795 | 06016 | 3 | 93984 | 32 |
| 29 | 4 8 | 55 52 | 69212 | 11 | 30788 | 75235 | 14 | 24765 | 06023 | 3 | 93977 | 31 |
| 30 | 8 4 0 | 3 56 0 | 9. 69234 | 11 | 10. 30766 | 9. 75264 | 15 | 10. 24736 | 10. 06030 | 4 | 9. 93970 | 30 |
| 31 | 3 52 | 56 8 | 69256 | 12 | 30744 | 75294 | 15 | 24706 | 06037 | 4 | 93963 | 29 |
| 32 | 3 44 | 56 16 | 69279 | 12 | 30721 | 75323 | 16 | 24677 | 06045 | 4 | 93955 | 28 |
| 33 | 3 36 | 56 24 | 69301 | 12 | 30699 | 75353 | 16 | 24647 | 06052 | 4 | 93948 | 27 |
| 34 | 3 28 | 56 32 | 69323 | 13 | 30677 | 75382 | 17 | 24618 | 06059 | 4 | 93941 | 26 |
| 35 | 8 3 20 | 3 56 40 | 9. 69345 | 13 | 10. 30655 | 9. 75411 | 17 | 10. 24589 | 10. 06066 | 4 | 9. 93934 | 25 |
| 36 | 3 12 | 56 48 | 69368 | 13 | 30632 | 75441 | 18 | 24559 | 06073 | 4 | 93927 | 24 |
| 37 | 3 4 | 56 56 | 69390 | 14 | 30610 | 75470 | 18 | 24530 | 06080 | 4 | 93920 | 23 |
| 38 | 2 56 | 57 4 | 69412 | 14 | 30588 | 75500 | 19 | 24500 | 06088 | 5 | 93912 | 22 |
| 39 | 2 48 | 57 12 | 69434 | 15 | 30566 | 75529 | 19 | 24471 | 06095 | 5 | 93905 | 21 |
| 40 | 8 2 40 | 3 57 20 | 9. 69456 | 15 | 10. 30544 | 9. 75558 | 20 | 10. 24442 | 10. 06102 | 5 | 9. 93898 | 20 |
| 41 | 2 32 | 57 28 | 69479 | 15 | 30521 | 75588 | 20 | 24412 | 06109 | 5 | 93891 | 19 |
| 42 | 2 24 | 57 36 | 69501 | 16 | 30499 | 75617 | 21 | 24383 | 06116 | 5 | 93884 | 18 |
| 43 | 2 16 | 57 44 | 69523 | 16 | 30477 | 75647 | 21 | 24353 | 06124 | 5 | 93876 | 17 |
| 44 | 2 8 | 57 52 | 69545 | 16 | 30455 | 75676 | 22 | 24324 | 06131 | 5 | 93869 | 16 |
| 45 | 8 2 0 | 3 58 0 | 9. 69567 | 17 | 10. 30433 | 9. 75705 | 22 | 10. 24295 | 10. 06138 | 5 | 9. 93862 | 15 |
| 46 | 1 52 | 58 8 | 69589 | 17 | 30411 | 75735 | 23 | 24265 | 06145 | 5 | 93855 | 14 |
| 47 | 1 44 | 58 16 | 69611 | 17 | 30389 | 75764 | 23 | 24236 | 06153 | 6 | 93847 | 13 |
| 48 | 1 36 | 58 24 | 69633 | 18 | 30367 | 75793 | 24 | 24207 | 06160 | 6 | 93840 | 12 |
| 49 | 1 28 | 58 32 | 69655 | 18 | 30345 | 75822 | 24 | 24178 | 06167 | 6 | 93833 | 11 |
| 50 | 8 1 20 | 3 58 40 | 9. 69677 | 19 | 10. 30323 | 9. 75852 | 25 | 10. 24148 | 10. 06174 | 6 | 9. 93826 | 10 |
| 51 | 1 12 | 58 48 | 69699 | 19 | 30301 | 75881 | 25 | 24119 | 06181 | 6 | 93819 | 9 |
| 52 | 1 4 | 58 56 | 69721 | 19 | 30279 | 75910 | 26 | 24090 | 06189 | 6 | 93811 | 8 |
| 53 | 0 56 | 59 4 | 69743 | 20 | 30257 | 75939 | 26 | 24061 | 06196 | 6 | 93804 | 7 |
| 54 | 0 48 | 59 12 | 69765 | 20 | 30235 | 75969 | 27 | 24031 | 06203 | 6 | 93797 | 6 |
| 55 | 8 0 40 | 3 59 20 | 9. 69787 | 20 | 10. 30213 | 9. 75998 | 27 | 10. 24002 | 10. 06211 | 7 | 9. 93789 | 5 |
| 56 | 0 32 | 59 28 | 69809 | 21 | 30191 | 76027 | 28 | 23973 | 06218 | 7 | 93782 | 4 |
| 57 | 0 24 | 59 36 | 69831 | 21 | 30169 | 76056 | 28 | 23944 | 06225 | 7 | 93775 | 3 |
| 58 | 0 16 | 59 44 | 69853 | 21 | 30147 | 76086 | 29 | 23914 | 06232 | 7 | 93768 | 2 |
| 59 | 0 8 | 59 52 | 69875 | 22 | 30125 | 76115 | 29 | 23885 | 06240 | 7 | 93760 | 1 |
| 60 | 0 0 | 4 0 0 | 69897 | 22 | 30103 | 76144 | 29 | 23856 | 06247 | 7 | 93753 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 8 0 0 | 4 0 0 | 9.60897 | 0 | 10.30103 | 9.76144 | 0 | 10.23856 | 10.06247 | 0 | 9.93753 | 60 |
| 1 | 7 59 52 | 0 8 | 69919 | 0 | 30081 | 76173 | 0 | 23827 | 06254 | 0 | 93746 | 59 |
| 2 | 59 44 | 0 16 | 69941 | 1 | 30059 | 76202 | 1 | 23798 | 06262 | 0 | 93738 | 58 |
| 3 | 59 36 | 0 24 | 69963 | 1 | 30037 | 76231 | 1 | 23769 | 06269 | 0 | 93731 | 57 |
| 4 | 59 28 | 0 32 | 69984 | 1 | 30016 | 76261 | 2 | 23739 | 06276 | 0 | 93724 | 56 |
| 5 | 7 59 20 | 4 0 40 | 9.70006 | 2 | 10.29994 | 9.76290 | 2 | 10.23710 | 10.06283 | 1 | 9.93717 | 55 |
| 6 | 59 12 | 0 48 | 70028 | 2 | 29972 | 76319 | 3 | 23681 | 06291 | 1 | 93709 | 54 |
| 7 | 59 4 | 0 56 | 70050 | 3 | 29950 | 76348 | 3 | 23652 | 06298 | 1 | 93702 | 53 |
| 8 | 58 56 | 1 4 | 70072 | 3 | 29928 | 76377 | 4 | 23623 | 06305 | 1 | 93695 | 52 |
| 9 | 58 48 | 1 12 | 70093 | 3 | 29907 | 76406 | 4 | 23594 | 06313 | 1 | 93687 | 51 |
| 10 | 7 58 40 | 4 1 20 | 9.70115 | 4 | 10.29885 | 9.76435 | 5 | 10.23565 | 10.06320 | 1 | 9.93680 | 50 |
| 11 | 58 32 | 1 28 | 70137 | 4 | 29863 | 76464 | 5 | 23536 | 06327 | 1 | 93673 | 49 |
| 12 | 58 24 | 1 36 | 70159 | 4 | 29841 | 76493 | 6 | 23507 | 06335 | 1 | 93665 | 48 |
| 13 | 58 16 | 1 44 | 70180 | 5 | 29820 | 76522 | 6 | 23478 | 06342 | 2 | 93658 | 47 |
| 14 | 58 8 | 1 52 | 70202 | 5 | 29798 | 76551 | 7 | 23449 | 06350 | 2 | 93650 | 46 |
| 15 | 7 58 0 | 4 2 0 | 9.70224 | 5 | 10.29776 | 9.76580 | 7 | 10.23420 | 10.06357 | 2 | 9.93643 | 45 |
| 16 | 57 52 | 2 8 | 70245 | 6 | 29755 | 76609 | 8 | 23391 | 06364 | 2 | 93635 | 44 |
| 17 | 57 44 | 2 16 | 70267 | 6 | 29733 | 76639 | 8 | 23361 | 06372 | 2 | 93628 | 43 |
| 18 | 57 36 | 2 24 | 70288 | 6 | 29712 | 76668 | 9 | 23332 | 06379 | 2 | 93621 | 42 |
| 19 | 57 28 | 2 32 | 70310 | 7 | 29690 | 76697 | 9 | 23303 | 06386 | 2 | 93614 | 41 |
| 20 | 7 57 20 | 4 2 40 | 9.70332 | 7 | 10.29668 | 9.76725 | 10 | 10.23275 | 10.06394 | 2 | 9.93606 | 40 |
| 21 | 57 12 | 2 48 | 70353 | 8 | 29647 | 76754 | 10 | 23246 | 06401 | 3 | 93599 | 39 |
| 22 | 57 4 | 2 56 | 70375 | 8 | 29625 | 76783 | 11 | 23217 | 06409 | 3 | 93591 | 38 |
| 23 | 56 56 | 3 4 | 70396 | 8 | 29604 | 76812 | 11 | 23188 | 06416 | 3 | 93584 | 37 |
| 24 | 56 48 | 3 12 | 70418 | 9 | 29582 | 76841 | 12 | 23159 | 06423 | 3 | 93577 | 36 |
| 25 | 7 56 40 | 4 3 20 | 9.70439 | 9 | 10.29561 | 9.76870 | 12 | 10.23130 | 10.06431 | 3 | 9.93569 | 35 |
| 26 | 56 32 | 3 28 | 70461 | 9 | 29539 | 76899 | 13 | 23101 | 06438 | 3 | 93562 | 34 |
| 27 | 56 24 | 3 36 | 70482 | 10 | 29518 | 76928 | 13 | 23072 | 06446 | 3 | 93554 | 33 |
| 28 | 56 16 | 3 44 | 70504 | 10 | 29496 | 76957 | 13 | 23043 | 06453 | 3 | 93547 | 32 |
| 29 | 56 8 | 3 52 | 70525 | 10 | 29475 | 76986 | 14 | 23014 | 06461 | 4 | 93539 | 31 |
| 30 | 7 56 0 | 4 4 0 | 9.70547 | 11 | 10.29453 | 9.77015 | 14 | 10.22985 | 10.06468 | 4 | 9.93532 | 30 |
| 31 | 55 52 | 4 8 | 70568 | 11 | 29432 | 77044 | 15 | 22956 | 06475 | 4 | 93525 | 29 |
| 32 | 55 44 | 4 16 | 70590 | 11 | 29410 | 77073 | 15 | 22927 | 06483 | 4 | 93517 | 28 |
| 33 | 55 36 | 4 24 | 70611 | 12 | 29389 | 77101 | 16 | 22899 | 06490 | 4 | 93510 | 27 |
| 34 | 55 28 | 4 32 | 70633 | 12 | 29367 | 77130 | 16 | 22870 | 06498 | 4 | 93502 | 26 |
| 35 | 7 55 20 | 4 4 40 | 9.70654 | 13 | 10.29346 | 9.77159 | 17 | 10.22841 | 10.06505 | 4 | 9.93495 | 25 |
| 36 | 55 12 | 4 48 | 70675 | 13 | 29325 | 77188 | 17 | 22812 | 06512 | 4 | 93487 | 24 |
| 37 | 55 4 | 4 56 | 70697 | 13 | 29303 | 77217 | 18 | 22783 | 06520 | 5 | 93480 | 23 |
| 38 | 54 56 | 5 4 | 70718 | 14 | 29282 | 77246 | 18 | 22754 | 06528 | 5 | 93472 | 22 |
| 39 | 54 48 | 5 12 | 70739 | 14 | 29261 | 77274 | 19 | 22726 | 06535 | 5 | 93465 | 21 |
| 40 | 7 54 40 | 4 5 20 | 9.70761 | 14 | 10.29239 | 9.77303 | 19 | 10.22697 | 10.06543 | 5 | 9.93457 | 20 |
| 41 | 54 32 | 5 28 | 70782 | 15 | 29218 | 77332 | 20 | 22668 | 06550 | 5 | 93450 | 19 |
| 42 | 54 24 | 5 36 | 70803 | 15 | 29197 | 77361 | 20 | 22639 | 06558 | 5 | 93442 | 18 |
| 43 | 54 16 | 5 44 | 70824 | 15 | 29176 | 77390 | 21 | 22610 | 06565 | 5 | 93435 | 17 |
| 44 | 54 8 | 5 52 | 70846 | 16 | 29154 | 77418 | 21 | 22582 | 06573 | 5 | 93427 | 16 |
| 45 | 7 54 0 | 4 6 0 | 9.70867 | 16 | 10.29133 | 9.77447 | 22 | 10.22553 | 10.06580 | 6 | 9.93420 | 15 |
| 46 | 53 52 | 6 8 | 70888 | 16 | 29112 | 77476 | 22 | 22524 | 06588 | 6 | 93412 | 14 |
| 47 | 53 44 | 6 16 | 70909 | 17 | 29091 | 77505 | 23 | 22495 | 06595 | 6 | 93405 | 13 |
| 48 | 53 36 | 6 24 | 70931 | 17 | 29069 | 77533 | 23 | 22467 | 06603 | 6 | 93397 | 12 |
| 49 | 53 28 | 6 32 | 70952 | 18 | 29048 | 77562 | 24 | 22438 | 06610 | 6 | 93390 | 11 |
| 50 | 7 53 20 | 4 6 40 | 9.70973 | 18 | 10.29027 | 9.77591 | 24 | 10.22409 | 10.06618 | 6 | 9.93382 | 10 |
| 51 | 53 12 | 6 48 | 70994 | 18 | 29006 | 77619 | 25 | 22381 | 06625 | 6 | 93375 | 9 |
| 52 | 53 4 | 6 56 | 71015 | 19 | 28985 | 77648 | 25 | 22352 | 06633 | 6 | 93367 | 8 |
| 53 | 52 56 | 7 4 | 71036 | 19 | 28964 | 77677 | 26 | 22323 | 06640 | 7 | 93360 | 7 |
| 54 | 52 48 | 7 12 | 71058 | 19 | 28942 | 77706 | 26 | 22294 | 06648 | 7 | 93352 | 6 |
| 55 | 7 52 40 | 4 7 20 | 9.71079 | 20 | 10.28921 | 9.77734 | 26 | 10.22266 | 10.06656 | 7 | 9.93344 | 5 |
| 56 | 52 32 | 7 28 | 71100 | 20 | 28900 | 77763 | 27 | 22237 | 06663 | 7 | 93337 | 4 |
| 57 | 52 24 | 7 36 | 71121 | 20 | 28879 | 77791 | 27 | 22209 | 06671 | 7 | 93329 | 3 |
| 58 | 52 16 | 7 44 | 71142 | 21 | 28858 | 77820 | 28 | 22180 | 06678 | 7 | 93322 | 2 |
| 59 | 52 8 | 7 52 | 71163 | 21 | 28837 | 77849 | 28 | 22151 | 06686 | 7 | 93314 | 1 |
| 60 | 52 0 | 8 0 | 71184 | 21 | 28816 | 77877 | 29 | 22123 | 06693 | 7 | 93307 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

| 31° | | | | | | | | | | | | 148° | |
|-----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|------|--|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | |
| 0 | 7 52 0 | 4 8 0 | 9. 71184 | 0 | 10. 28816 | 9. 77877 | 0 | 10. 22123 | 10. 06693 | 0 | 9. 93307 | 60 | |
| 1 | 51 52 | 8 8 | 71205 | 0 | 28795 | 77906 | 0 | 22094 | 06701 | 0 | 93299 | 59 | |
| 2 | 51 44 | 8 16 | 71226 | 1 | 28774 | 77935 | 1 | 22065 | 06709 | 0 | 93291 | 58 | |
| 3 | 51 36 | 8 24 | 71247 | 1 | 28753 | 77963 | 1 | 22037 | 06716 | 0 | 93284 | 57 | |
| 4 | 51 28 | 8 32 | 71268 | 1 | 28732 | 77992 | 2 | 22008 | 06724 | 1 | 93276 | 56 | |
| 5 | 7 51 20 | 4 8 40 | 9. 71289 | 2 | 10. 28711 | 9. 78020 | 2 | 10. 21980 | 10. 06731 | 1 | 9. 93269 | 55 | |
| 6 | 51 12 | 8 48 | 71310 | 2 | 28690 | 78049 | 3 | 21951 | 06739 | 1 | 93261 | 54 | |
| 7 | 51 4 | 8 56 | 71331 | 2 | 28669 | 78077 | 3 | 21923 | 06747 | 1 | 93253 | 53 | |
| 8 | 50 56 | 9 4 | 71352 | 3 | 28648 | 78106 | 4 | 21894 | 06754 | 1 | 93246 | 52 | |
| 9 | 50 48 | 9 12 | 71373 | 3 | 28627 | 78135 | 4 | 21865 | 06762 | 1 | 93238 | 51 | |
| 10 | 7 50 40 | 4 9 20 | 9. 71393 | 3 | 10. 28607 | 9. 78163 | 5 | 10. 21837 | 10. 06770 | 1 | 9. 93230 | 50 | |
| 11 | 50 32 | 9 28 | 71414 | 4 | 28586 | 78192 | 5 | 21808 | 06777 | 1 | 93223 | 49 | |
| 12 | 50 24 | 9 36 | 71435 | 4 | 28565 | 78220 | 6 | 21780 | 06785 | 2 | 93215 | 48 | |
| 13 | 50 16 | 9 44 | 71456 | 4 | 28544 | 78249 | 6 | 21751 | 06793 | 2 | 93207 | 47 | |
| 14 | 50 8 | 9 52 | 71477 | 5 | 28523 | 78277 | 7 | 21723 | 06800 | 2 | 93200 | 46 | |
| 15 | 7 50 0 | 4 10 0 | 9. 71498 | 5 | 10. 28502 | 9. 78306 | 7 | 10. 21694 | 10. 06808 | 2 | 9. 93192 | 45 | |
| 16 | 49 52 | 10 8 | 71519 | 5 | 28481 | 78334 | 8 | 21666 | 06816 | 2 | 93184 | 44 | |
| 17 | 49 44 | 10 16 | 71539 | 5 | 28461 | 78363 | 8 | 21637 | 06823 | 2 | 93177 | 43 | |
| 18 | 49 36 | 10 24 | 71560 | 6 | 28440 | 78391 | 9 | 21609 | 06831 | 2 | 93169 | 42 | |
| 19 | 49 28 | 10 32 | 71581 | 7 | 28419 | 78419 | 9 | 21581 | 06839 | 2 | 93161 | 41 | |
| 20 | 7 49 20 | 4 10 40 | 9. 71602 | 7 | 10. 28398 | 9. 78448 | 9 | 10. 21552 | 10. 06846 | 3 | 9. 93154 | 40 | |
| 21 | 49 12 | 10 48 | 71622 | 7 | 28378 | 78476 | 10 | 21524 | 06854 | 3 | 93146 | 39 | |
| 22 | 49 4 | 10 56 | 71643 | 8 | 28357 | 78505 | 10 | 21495 | 06862 | 3 | 93138 | 38 | |
| 23 | 48 56 | 11 4 | 71664 | 8 | 28336 | 78533 | 11 | 21467 | 06869 | 3 | 93131 | 37 | |
| 24 | 48 48 | 11 12 | 71685 | 8 | 28315 | 78562 | 11 | 21438 | 06877 | 3 | 93123 | 36 | |
| 25 | 7 48 40 | 4 11 20 | 9. 71705 | 9 | 10. 28295 | 9. 78590 | 12 | 10. 21410 | 10. 06885 | 3 | 9. 93115 | 35 | |
| 26 | 48 32 | 11 28 | 71726 | 9 | 28274 | 78618 | 12 | 21382 | 06892 | 3 | 93108 | 34 | |
| 27 | 48 24 | 11 36 | 71747 | 9 | 28253 | 78647 | 13 | 21353 | 06900 | 3 | 93100 | 33 | |
| 28 | 48 16 | 11 44 | 71767 | 10 | 28233 | 78675 | 13 | 21325 | 06908 | 4 | 93092 | 32 | |
| 29 | 48 8 | 11 52 | 71788 | 10 | 28212 | 78704 | 14 | 21296 | 06916 | 4 | 93084 | 31 | |
| 30 | 7 48 0 | 4 12 0 | 9. 71809 | 10 | 10. 28191 | 9. 78732 | 14 | 10. 21268 | 10. 06923 | 4 | 9. 93077 | 30 | |
| 31 | 47 52 | 12 8 | 71829 | 11 | 28171 | 78760 | 15 | 21240 | 06931 | 4 | 93069 | 29 | |
| 32 | 47 44 | 12 16 | 71850 | 11 | 28150 | 78789 | 15 | 21211 | 06939 | 4 | 93061 | 28 | |
| 33 | 47 36 | 12 24 | 71870 | 11 | 28130 | 78817 | 16 | 21183 | 06947 | 4 | 93053 | 27 | |
| 34 | 47 28 | 12 32 | 71891 | 12 | 28109 | 78845 | 16 | 21155 | 06954 | 4 | 93046 | 26 | |
| 35 | 7 47 20 | 4 12 40 | 9. 71911 | 12 | 10. 28089 | 9. 78874 | 17 | 10. 21126 | 10. 06962 | 5 | 9. 93038 | 25 | |
| 36 | 47 12 | 12 48 | 71932 | 12 | 28068 | 78902 | 17 | 21098 | 06970 | 5 | 93030 | 24 | |
| 37 | 47 4 | 12 56 | 71952 | 13 | 28048 | 78930 | 17 | 21070 | 06978 | 5 | 93022 | 23 | |
| 38 | 46 56 | 13 4 | 71973 | 13 | 28027 | 78959 | 18 | 21041 | 06986 | 5 | 93014 | 22 | |
| 39 | 46 48 | 13 12 | 71994 | 13 | 28006 | 78987 | 18 | 21013 | 06993 | 5 | 93007 | 21 | |
| 40 | 7 46 40 | 4 13 20 | 9. 72014 | 14 | 10. 27986 | 9. 79015 | 19 | 10. 20985 | 10. 07001 | 5 | 9. 92999 | 20 | |
| 41 | 46 32 | 13 28 | 72034 | 14 | 27966 | 79043 | 19 | 20957 | 07009 | 5 | 92991 | 19 | |
| 42 | 46 24 | 13 36 | 72055 | 14 | 27945 | 79072 | 20 | 20928 | 07017 | 5 | 92983 | 18 | |
| 43 | 46 16 | 13 44 | 72075 | 15 | 27925 | 79100 | 20 | 20900 | 07024 | 6 | 92976 | 17 | |
| 44 | 46 8 | 13 52 | 72096 | 15 | 27904 | 79128 | 21 | 20872 | 07032 | 6 | 92968 | 16 | |
| 45 | 7 46 0 | 4 14 0 | 9. 72116 | 15 | 10. 27884 | 9. 79156 | 21 | 10. 20844 | 10. 07040 | 6 | 9. 92960 | 15 | |
| 46 | 45 52 | 14 8 | 72137 | 16 | 27863 | 79185 | 22 | 20815 | 07048 | 6 | 92952 | 14 | |
| 47 | 45 44 | 14 16 | 72157 | 16 | 27843 | 79213 | 22 | 20787 | 07056 | 6 | 92944 | 13 | |
| 48 | 45 36 | 14 24 | 72177 | 16 | 27823 | 79241 | 23 | 20759 | 07064 | 6 | 92936 | 12 | |
| 49 | 45 28 | 14 32 | 72198 | 17 | 27802 | 79269 | 23 | 20731 | 07071 | 6 | 92929 | 11 | |
| 50 | 7 45 20 | 4 14 40 | 9. 72218 | 17 | 10. 27782 | 9. 79297 | 24 | 10. 20703 | 10. 07079 | 6 | 9. 92921 | 10 | |
| 51 | 45 12 | 14 48 | 72238 | 18 | 27762 | 79326 | 24 | 20674 | 07087 | 7 | 92913 | 9 | |
| 52 | 45 4 | 14 56 | 72259 | 18 | 27741 | 79354 | 25 | 20646 | 07095 | 7 | 92905 | 8 | |
| 53 | 44 56 | 15 4 | 72279 | 18 | 27721 | 79382 | 25 | 20618 | 07103 | 7 | 92897 | 7 | |
| 54 | 44 48 | 15 12 | 72299 | 19 | 27701 | 79410 | 26 | 20590 | 07111 | 7 | 92889 | 6 | |
| 55 | 7 44 40 | 4 15 20 | 9. 72320 | 19 | 10. 27680 | 9. 79438 | 26 | 10. 20562 | 10. 07119 | 7 | 9. 92881 | 5 | |
| 56 | 44 32 | 15 28 | 72340 | 19 | 27660 | 79466 | 26 | 20534 | 07126 | 7 | 92874 | 4 | |
| 57 | 44 24 | 15 36 | 72360 | 20 | 27640 | 79495 | 27 | 20505 | 07134 | 7 | 92866 | 3 | |
| 58 | 44 16 | 15 44 | 72381 | 20 | 27619 | 79523 | 27 | 20477 | 07142 | 7 | 92858 | 2 | |
| 59 | 44 8 | 15 52 | 72401 | 20 | 27599 | 79551 | 28 | 20449 | 07150 | 8 | 92850 | 1 | |
| 60 | 44 0 | 16 0 | 72421 | 21 | 27579 | 79579 | 28 | 20421 | 07158 | 8 | 92842 | 0 | |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. | |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 7 44 0 | 4 16 0 | 9.72421 | 0 | 10.27579 | 9.79579 | 0 | 10.20421 | 10.07158 | 0 | 9.92842 | 60 |
| 1 | 43 52 | 16 8 | 72441 | 0 | 27559 | 79607 | 0 | 20393 | 07166 | 0 | 92834 | 59 |
| 2 | 43 44 | 16 16 | 72461 | 1 | 27539 | 79635 | 1 | 20365 | 07174 | 0 | 92826 | 58 |
| 3 | 43 36 | 16 24 | 72482 | 1 | 27518 | 79663 | 1 | 20337 | 07182 | 0 | 92818 | 57 |
| 4 | 43 28 | 16 32 | 72502 | 1 | 27498 | 79691 | 2 | 20309 | 07190 | 1 | 92810 | 56 |
| 5 | 7 43 20 | 4 16 40 | 9.72522 | 2 | 10.27478 | 9.79719 | 2 | 10.20281 | 10.07197 | 1 | 9.92803 | 55 |
| 6 | 43 12 | 16 48 | 72542 | 2 | 27458 | 79747 | 3 | 20253 | 07205 | 1 | 92795 | 54 |
| 7 | 43 4 | 16 56 | 72562 | 2 | 27438 | 79776 | 3 | 20224 | 07213 | 1 | 92787 | 53 |
| 8 | 42 56 | 17 4 | 72582 | 3 | 27418 | 79804 | 4 | 20196 | 07221 | 1 | 92779 | 52 |
| 9 | 42 48 | 17 12 | 72602 | 3 | 27398 | 79832 | 4 | 20168 | 07229 | 1 | 92771 | 51 |
| 10 | 7 42 40 | 4 17 20 | 9.72622 | 3 | 10.27378 | 9.79860 | 5 | 10.20140 | 10.07237 | 1 | 9.92763 | 50 |
| 11 | 42 32 | 17 28 | 72643 | 4 | 27357 | 79888 | 5 | 20112 | 07245 | 1 | 92755 | 49 |
| 12 | 42 24 | 17 36 | 72663 | 4 | 27337 | 79916 | 6 | 20084 | 07253 | 2 | 92747 | 48 |
| 13 | 42 16 | 17 44 | 72683 | 4 | 27317 | 79944 | 6 | 20056 | 07261 | 2 | 92739 | 47 |
| 14 | 42 8 | 17 52 | 72703 | 5 | 27297 | 79972 | 7 | 20028 | 07269 | 2 | 92731 | 46 |
| 15 | 7 42 0 | 4 18 0 | 9.72723 | 5 | 10.27277 | 9.80000 | 7 | 10.20000 | 10.07277 | 2 | 9.92723 | 45 |
| 16 | 41 52 | 18 8 | 72743 | 5 | 27257 | 80028 | 7 | 19972 | 07285 | 2 | 92715 | 44 |
| 17 | 41 44 | 18 16 | 72763 | 6 | 27237 | 80056 | 8 | 19944 | 07293 | 2 | 92707 | 43 |
| 18 | 41 36 | 18 24 | 72783 | 6 | 27217 | 80084 | 8 | 19916 | 07301 | 2 | 92699 | 42 |
| 19 | 41 28 | 18 32 | 72803 | 6 | 27197 | 80112 | 9 | 19888 | 07309 | 3 | 92691 | 41 |
| 20 | 7 41 20 | 4 18 40 | 9.72823 | 7 | 10.27177 | 9.80140 | 9 | 10.19860 | 10.07317 | 3 | 9.92683 | 40 |
| 21 | 41 12 | 18 48 | 72843 | 7 | 27157 | 80168 | 10 | 19832 | 07325 | 3 | 92675 | 39 |
| 22 | 41 4 | 18 56 | 72863 | 7 | 27137 | 80195 | 10 | 19805 | 07333 | 3 | 92667 | 38 |
| 23 | 40 56 | 19 4 | 72883 | 8 | 27117 | 80223 | 11 | 19777 | 07341 | 3 | 92659 | 37 |
| 24 | 40 48 | 19 12 | 72902 | 8 | 27098 | 80251 | 11 | 19749 | 07349 | 3 | 92651 | 36 |
| 25 | 7 40 40 | 4 19 20 | 9.72922 | 8 | 10.27078 | 9.80279 | 12 | 10.19721 | 10.07357 | 3 | 9.92643 | 35 |
| 26 | 40 32 | 19 28 | 72942 | 9 | 27058 | 80307 | 12 | 19693 | 07365 | 3 | 92635 | 34 |
| 27 | 40 24 | 19 36 | 72962 | 9 | 27038 | 80335 | 13 | 19665 | 07373 | 4 | 92627 | 33 |
| 28 | 40 16 | 19 44 | 72982 | 9 | 27018 | 80363 | 13 | 19637 | 07381 | 4 | 92619 | 32 |
| 29 | 40 8 | 19 52 | 73002 | 10 | 26998 | 80391 | 13 | 19609 | 07389 | 4 | 92611 | 31 |
| 30 | 7 40 0 | 4 20 0 | 9.73022 | 10 | 10.26978 | 9.80419 | 14 | 10.19581 | 10.07397 | 4 | 9.92603 | 30 |
| 31 | 39 52 | 20 8 | 73041 | 10 | 26959 | 80447 | 14 | 19553 | 07405 | 4 | 92595 | 29 |
| 32 | 39 44 | 20 16 | 73061 | 11 | 26939 | 80474 | 15 | 19526 | 07413 | 4 | 92587 | 28 |
| 33 | 39 36 | 20 24 | 73081 | 11 | 26919 | 80502 | 15 | 19498 | 07421 | 4 | 92579 | 27 |
| 34 | 39 28 | 20 32 | 73101 | 11 | 26899 | 80530 | 16 | 19470 | 07429 | 5 | 92571 | 26 |
| 35 | 7 39 20 | 4 20 40 | 9.73121 | 12 | 10.26879 | 9.80558 | 16 | 10.19442 | 10.07437 | 5 | 9.92563 | 25 |
| 36 | 39 12 | 20 48 | 73140 | 12 | 26860 | 80586 | 17 | 19414 | 07445 | 5 | 92555 | 24 |
| 37 | 39 4 | 20 56 | 73160 | 12 | 26840 | 80614 | 17 | 19386 | 07453 | 5 | 92546 | 23 |
| 38 | 38 56 | 21 4 | 73180 | 13 | 26820 | 80642 | 18 | 19358 | 07462 | 5 | 92538 | 22 |
| 39 | 38 48 | 21 12 | 73200 | 13 | 26800 | 80669 | 18 | 19331 | 07470 | 5 | 92530 | 21 |
| 40 | 7 38 40 | 4 21 20 | 9.73219 | 13 | 10.26781 | 9.80697 | 19 | 10.19303 | 10.07478 | 5 | 9.92522 | 20 |
| 41 | 38 32 | 21 28 | 73239 | 14 | 26761 | 80725 | 19 | 19275 | 07486 | 6 | 92514 | 19 |
| 42 | 38 24 | 21 36 | 73259 | 14 | 26741 | 80753 | 20 | 19247 | 07494 | 6 | 92506 | 18 |
| 43 | 38 16 | 21 44 | 73278 | 14 | 26722 | 80781 | 20 | 19219 | 07502 | 6 | 92498 | 17 |
| 44 | 38 8 | 21 52 | 73298 | 15 | 26702 | 80808 | 20 | 19192 | 07510 | 6 | 92490 | 16 |
| 45 | 7 38 0 | 4 22 0 | 9.73318 | 15 | 10.26682 | 9.80836 | 21 | 10.19164 | 10.07518 | 6 | 9.92482 | 15 |
| 46 | 37 52 | 22 8 | 73337 | 15 | 26663 | 80864 | 21 | 19136 | 07527 | 6 | 92473 | 14 |
| 47 | 37 44 | 22 16 | 73357 | 16 | 26643 | 80892 | 22 | 19108 | 07535 | 6 | 92465 | 13 |
| 48 | 37 36 | 22 24 | 73377 | 16 | 26623 | 80919 | 22 | 19081 | 07543 | 6 | 92457 | 12 |
| 49 | 37 28 | 22 32 | 73396 | 16 | 26604 | 80947 | 23 | 19053 | 07551 | 7 | 92449 | 11 |
| 50 | 7 37 20 | 4 22 40 | 9.73416 | 17 | 10.26584 | 9.80975 | 23 | 10.19025 | 10.07559 | 7 | 9.92441 | 10 |
| 51 | 37 12 | 22 48 | 73435 | 17 | 26565 | 81003 | 24 | 18997 | 07567 | 7 | 92433 | 9 |
| 52 | 37 4 | 22 56 | 73455 | 17 | 26545 | 81030 | 24 | 18970 | 07575 | 7 | 92425 | 8 |
| 53 | 36 56 | 23 4 | 73474 | 18 | 26526 | 81058 | 25 | 18942 | 07584 | 7 | 92416 | 7 |
| 54 | 36 48 | 23 12 | 73494 | 18 | 26506 | 81086 | 25 | 18914 | 07592 | 7 | 92408 | 6 |
| 55 | 7 36 40 | 4 23 20 | 9.73513 | 18 | 10.26487 | 9.81113 | 26 | 10.18887 | 10.07600 | 7 | 9.92400 | 5 |
| 56 | 36 32 | 23 28 | 73533 | 19 | 26467 | 81141 | 26 | 18859 | 07608 | 8 | 92392 | 4 |
| 57 | 36 24 | 23 36 | 73552 | 19 | 26448 | 81169 | 26 | 18831 | 07616 | 8 | 92384 | 3 |
| 58 | 36 16 | 23 44 | 73572 | 19 | 26428 | 81196 | 27 | 18804 | 07624 | 8 | 92376 | 2 |
| 59 | 36 8 | 23 52 | 73591 | 20 | 26409 | 81224 | 27 | 18776 | 07633 | 8 | 92367 | 1 |
| 60 | 36 0 | 24 0 | 73611 | 20 | 26389 | 81252 | 28 | 18748 | 07641 | 8 | 92359 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 7 36 0 | 4 24 0 | 9. 73611 | 0 | 10. 26389 | 9. 81252 | 0 | 10. 18748 | 10. 07641 | 0 | 9. 92359 | 60 |
| 1 | 35 52 | 24 8 | 73630 | 0 | 26370 | 81279 | 0 | 18721 | 07649 | 0 | 92351 | 59 |
| 2 | 35 44 | 24 16 | 73650 | 1 | 26350 | 81307 | 1 | 18693 | 07657 | 0 | 92343 | 58 |
| 3 | 35 36 | 24 24 | 73669 | 1 | 26331 | 81335 | 1 | 18665 | 07665 | 0 | 92335 | 57 |
| 4 | 35 28 | 24 32 | 73689 | 1 | 26311 | 81362 | 2 | 18638 | 07674 | 1 | 92326 | 56 |
| 5 | 7 35 20 | 4 24 40 | 9. 73708 | 2 | 10. 26292 | 9. 81390 | 2 | 10. 18610 | 10. 07682 | 1 | 9. 92318 | 55 |
| 6 | 35 12 | 24 48 | 73727 | 2 | 26273 | 81418 | 3 | 18582 | 07690 | 1 | 92310 | 54 |
| 7 | 35 4 | 24 56 | 73747 | 2 | 26253 | 81445 | 3 | 18555 | 07698 | 1 | 92302 | 53 |
| 8 | 34 56 | 25 4 | 73766 | 3 | 26234 | 81473 | 4 | 18527 | 07707 | 1 | 92293 | 52 |
| 9 | 34 48 | 25 12 | 73785 | 3 | 26215 | 81500 | 4 | 18500 | 07715 | 1 | 92285 | 51 |
| 10 | 7 34 40 | 4 25 20 | 9. 73805 | 3 | 10. 26195 | 9. 81528 | 5 | 10. 18472 | 10. 07723 | 1 | 9. 92277 | 50 |
| 11 | 34 32 | 25 28 | 73824 | 3 | 26176 | 81556 | 5 | 18444 | 07731 | 2 | 92269 | 49 |
| 12 | 34 24 | 25 36 | 73843 | 4 | 26157 | 81583 | 5 | 18417 | 07740 | 2 | 92260 | 48 |
| 13 | 34 16 | 25 44 | 73863 | 4 | 26137 | 81611 | 6 | 18389 | 07748 | 2 | 92252 | 47 |
| 14 | 34 8 | 25 52 | 73882 | 4 | 26118 | 81638 | 6 | 18362 | 07756 | 2 | 92244 | 46 |
| 15 | 7 34 0 | 4 26 0 | 9. 73901 | 5 | 10. 26099 | 9. 81666 | 7 | 10. 18334 | 10. 07765 | 2 | 9. 92235 | 45 |
| 16 | 33 52 | 26 8 | 73921 | 5 | 26079 | 81693 | 7 | 18307 | 07773 | 2 | 92227 | 44 |
| 17 | 33 44 | 26 16 | 73940 | 5 | 26060 | 81721 | 8 | 18279 | 07781 | 2 | 92219 | 43 |
| 18 | 33 36 | 26 24 | 73959 | 6 | 26041 | 81748 | 8 | 18252 | 07789 | 3 | 92211 | 42 |
| 19 | 33 28 | 26 32 | 73978 | 6 | 26022 | 81776 | 9 | 18224 | 07798 | 3 | 92202 | 41 |
| 20 | 7 33 20 | 4 26 40 | 9. 73997 | 6 | 10. 26003 | 9. 81803 | 9 | 10. 18197 | 10. 07806 | 3 | 9. 92194 | 40 |
| 21 | 33 12 | 26 48 | 74017 | 7 | 25983 | 81831 | 10 | 18169 | 07814 | 3 | 92186 | 39 |
| 22 | 33 4 | 26 56 | 74036 | 7 | 25964 | 81858 | 10 | 18142 | 07823 | 3 | 92177 | 38 |
| 23 | 32 56 | 27 4 | 74055 | 7 | 25945 | 81886 | 11 | 18114 | 07831 | 3 | 92169 | 37 |
| 24 | 32 48 | 27 12 | 74074 | 8 | 25926 | 81913 | 11 | 18087 | 07839 | 3 | 92161 | 36 |
| 25 | 7 32 40 | 4 27 20 | 9. 74093 | 8 | 10. 25907 | 9. 81941 | 11 | 10. 18059 | 10. 07848 | 3 | 9. 92152 | 35 |
| 26 | 32 32 | 27 28 | 74113 | 8 | 25887 | 81968 | 12 | 18032 | 07856 | 4 | 92144 | 34 |
| 27 | 32 24 | 27 36 | 74132 | 9 | 25868 | 81996 | 12 | 18004 | 07864 | 4 | 92136 | 33 |
| 28 | 32 16 | 27 44 | 74151 | 9 | 25849 | 82023 | 13 | 17977 | 07873 | 4 | 92127 | 32 |
| 29 | 32 8 | 27 52 | 74170 | 9 | 25830 | 82051 | 13 | 17949 | 07881 | 4 | 92119 | 31 |
| 30 | 7 32 0 | 4 28 0 | 9. 74189 | 10 | 10. 25811 | 9. 82078 | 14 | 10. 17922 | 10. 07889 | 4 | 9. 92111 | 30 |
| 31 | 31 52 | 28 8 | 74208 | 10 | 25792 | 82106 | 14 | 17894 | 07898 | 4 | 92102 | 29 |
| 32 | 31 44 | 28 16 | 74227 | 10 | 25773 | 82133 | 15 | 17867 | 07906 | 4 | 92094 | 28 |
| 33 | 31 36 | 28 24 | 74246 | 10 | 25754 | 82161 | 15 | 17839 | 07914 | 5 | 92086 | 27 |
| 34 | 31 28 | 28 32 | 74265 | 11 | 25735 | 82188 | 16 | 17812 | 07923 | 5 | 92077 | 26 |
| 35 | 7 31 20 | 4 28 40 | 9. 74284 | 11 | 10. 25716 | 9. 82215 | 16 | 10. 17785 | 10. 07931 | 5 | 9. 92069 | 25 |
| 36 | 31 12 | 28 48 | 74303 | 11 | 25697 | 82243 | 16 | 17757 | 07940 | 5 | 92060 | 24 |
| 37 | 31 4 | 28 56 | 74322 | 12 | 25678 | 82270 | 17 | 17730 | 07948 | 5 | 92052 | 23 |
| 38 | 30 56 | 29 4 | 74341 | 12 | 25659 | 82298 | 17 | 17702 | 07956 | 5 | 92044 | 22 |
| 39 | 30 48 | 29 12 | 74360 | 12 | 25640 | 82325 | 18 | 17675 | 07965 | 5 | 92035 | 21 |
| 40 | 7 30 40 | 4 29 20 | 9. 74379 | 13 | 10. 25621 | 9. 82352 | 18 | 10. 17648 | 10. 07973 | 6 | 9. 92027 | 20 |
| 41 | 30 32 | 29 28 | 74398 | 13 | 25602 | 82380 | 19 | 17620 | 07982 | 6 | 92018 | 19 |
| 42 | 30 24 | 29 36 | 74417 | 13 | 25583 | 82407 | 19 | 17593 | 07990 | 6 | 92010 | 18 |
| 43 | 30 16 | 29 44 | 74436 | 14 | 25564 | 82435 | 20 | 17565 | 07998 | 6 | 92002 | 17 |
| 44 | 30 8 | 29 52 | 74455 | 14 | 25545 | 82462 | 20 | 17538 | 08007 | 6 | 91993 | 16 |
| 45 | 7 30 0 | 4 30 0 | 9. 74474 | 14 | 10. 25526 | 9. 82489 | 21 | 10. 17511 | 10. 08015 | 6 | 9. 91985 | 15 |
| 46 | 29 52 | 30 8 | 74493 | 15 | 25507 | 82517 | 21 | 17483 | 08024 | 6 | 91976 | 14 |
| 47 | 29 44 | 30 16 | 74512 | 15 | 25488 | 82544 | 22 | 17456 | 08032 | 7 | 91968 | 13 |
| 48 | 29 36 | 30 24 | 74531 | 15 | 25469 | 82571 | 22 | 17429 | 08041 | 7 | 91959 | 12 |
| 49 | 29 28 | 30 32 | 74549 | 16 | 25451 | 82599 | 22 | 17401 | 08049 | 7 | 91951 | 11 |
| 50 | 7 29 20 | 4 30 40 | 9. 74568 | 16 | 10. 25432 | 9. 82626 | 23 | 10. 17374 | 10. 08058 | 7 | 9. 91942 | 10 |
| 51 | 29 12 | 30 48 | 74587 | 16 | 25413 | 82653 | 23 | 17347 | 08066 | 7 | 91934 | 9 |
| 52 | 29 4 | 30 56 | 74606 | 17 | 25394 | 82681 | 24 | 17319 | 08075 | 7 | 91925 | 8 |
| 53 | 28 56 | 31 4 | 74625 | 17 | 25375 | 82708 | 24 | 17292 | 08083 | 7 | 91917 | 7 |
| 54 | 28 48 | 31 12 | 74644 | 17 | 25356 | 82735 | 25 | 17265 | 08092 | 8 | 91908 | 6 |
| 55 | 7 28 40 | 4 31 20 | 9. 74662 | 17 | 10. 25338 | 9. 82762 | 25 | 10. 17238 | 10. 08100 | 8 | 9. 91900 | 5 |
| 56 | 28 32 | 31 28 | 74681 | 18 | 25319 | 82790 | 26 | 17210 | 08109 | 8 | 91891 | 4 |
| 57 | 28 24 | 31 36 | 74700 | 18 | 25300 | 82817 | 26 | 17183 | 08117 | 8 | 91883 | 3 |
| 58 | 28 16 | 31 44 | 74719 | 18 | 25281 | 82844 | 27 | 17156 | 08126 | 8 | 91874 | 2 |
| 59 | 28 8 | 31 52 | 74737 | 19 | 25263 | 82871 | 27 | 17129 | 08134 | 8 | 91866 | 1 |
| 60 | 28 0 | 32 0 | 74756 | 19 | 25244 | 82899 | 27 | 17101 | 08143 | 8 | 91857 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|----------|-------|------------|----------|-------|---------|----|
| 0 | 7 28 0 | 4 32 0 | 9.74756 | 0 | 10.25244 | 9.82899 | 0 | 10.17101 | 10.08143 | 0 | 9.91857 | 60 |
| 1 | 27 52 | 32 8 | 74775 | 0 | 25225 | 82926 | 0 | 17074 | 08151 | 0 | 91849 | 59 |
| 2 | 27 44 | 32 16 | 74794 | 1 | 25206 | 82953 | 1 | 17047 | 08160 | 0 | 91840 | 58 |
| 3 | 27 36 | 32 24 | 74812 | 1 | 25188 | 82980 | 1 | 17020 | 08168 | 0 | 91832 | 57 |
| 4 | 27 28 | 32 32 | 74831 | 1 | 25169 | 83008 | 2 | 16992 | 08177 | 1 | 91823 | 56 |
| 5 | 7 27 20 | 4 32 40 | 9.74850 | 2 | 10.25150 | 9.83035 | 2 | 10.16965 | 10.08185 | 1 | 9.91815 | 55 |
| 6 | 27 12 | 32 48 | 74868 | 2 | 25132 | 83062 | 3 | 16938 | 08194 | 1 | 91806 | 54 |
| 7 | 27 4 | 32 56 | 74887 | 2 | 25113 | 83089 | 3 | 16911 | 08202 | 1 | 91798 | 53 |
| 8 | 26 56 | 33 4 | 74906 | 2 | 25094 | 83117 | 4 | 16883 | 08211 | 1 | 91789 | 52 |
| 9 | 26 48 | 33 12 | 74924 | 3 | 25076 | 83144 | 4 | 16856 | 08219 | 1 | 91781 | 51 |
| 10 | 7 26 40 | 4 33 20 | 9.74943 | 3 | 10.25057 | 9.83171 | 5 | 10.16829 | 10.08228 | 1 | 9.91772 | 50 |
| 11 | 26 32 | 33 28 | 74961 | 3 | 25039 | 83198 | 5 | 16802 | 08237 | 2 | 91763 | 49 |
| 12 | 26 24 | 33 36 | 74980 | 4 | 25020 | 83225 | 5 | 16775 | 08245 | 2 | 91755 | 48 |
| 13 | 26 16 | 33 44 | 74999 | 4 | 25001 | 83252 | 6 | 16748 | 08254 | 2 | 91746 | 47 |
| 14 | 26 8 | 33 52 | 75017 | 4 | 24983 | 83280 | 6 | 16720 | 08262 | 2 | 91738 | 46 |
| 15 | 7 26 0 | 4 34 0 | 9.75036 | 5 | 10.24964 | 9.83307 | 7 | 10.16693 | 10.08271 | 2 | 9.91729 | 45 |
| 16 | 25 52 | 34 8 | 75054 | 5 | 24946 | 83334 | 7 | 16666 | 08280 | 2 | 91720 | 44 |
| 17 | 25 44 | 34 16 | 75073 | 5 | 24927 | 83361 | 8 | 16639 | 08288 | 2 | 91712 | 43 |
| 18 | 25 36 | 34 24 | 75091 | 6 | 24909 | 83388 | 8 | 16612 | 08297 | 3 | 91703 | 42 |
| 19 | 25 28 | 34 32 | 75110 | 6 | 24890 | 83415 | 9 | 16585 | 08305 | 3 | 91695 | 41 |
| 20 | 7 25 20 | 4 34 40 | 9.75128 | 6 | 10.24872 | 9.83442 | 9 | 10.16558 | 10.08314 | 3 | 9.91686 | 40 |
| 21 | 25 12 | 34 48 | 75147 | 6 | 24853 | 83470 | 9 | 16530 | 08323 | 3 | 91677 | 39 |
| 22 | 25 4 | 34 56 | 75165 | 7 | 24835 | 83497 | 10 | 16503 | 08331 | 3 | 91669 | 38 |
| 23 | 24 56 | 35 4 | 75184 | 7 | 24816 | 83524 | 10 | 16476 | 08340 | 3 | 91660 | 37 |
| 24 | 24 48 | 35 12 | 75202 | 7 | 24798 | 83551 | 11 | 16449 | 08349 | 3 | 91651 | 36 |
| 25 | 7 24 40 | 4 35 20 | 9.75221 | 8 | 10.24779 | 9.83578 | 11 | 10.16422 | 10.08357 | 4 | 9.91643 | 35 |
| 26 | 24 32 | 35 28 | 75240 | 8 | 24761 | 83605 | 12 | 16395 | 08366 | 4 | 91634 | 34 |
| 27 | 24 24 | 35 36 | 75258 | 8 | 24742 | 83632 | 12 | 16368 | 08375 | 4 | 91625 | 33 |
| 28 | 24 16 | 35 44 | 75276 | 9 | 24724 | 83659 | 13 | 16341 | 08383 | 4 | 91617 | 32 |
| 29 | 24 8 | 35 52 | 75294 | 9 | 24706 | 83686 | 13 | 16314 | 08392 | 4 | 91608 | 31 |
| 30 | 7 24 0 | 4 36 0 | 9.75313 | 9 | 10.24687 | 9.83713 | 14 | 10.16287 | 10.08401 | 4 | 9.91599 | 30 |
| 31 | 23 52 | 36 8 | 75331 | 9 | 24669 | 83740 | 14 | 16260 | 08409 | 4 | 91591 | 29 |
| 32 | 23 44 | 36 16 | 75350 | 10 | 24650 | 83768 | 14 | 16232 | 08418 | 5 | 91582 | 28 |
| 33 | 23 36 | 36 24 | 75368 | 10 | 24632 | 83795 | 15 | 16205 | 08427 | 5 | 91573 | 27 |
| 34 | 23 28 | 36 32 | 75386 | 10 | 24614 | 83822 | 15 | 16178 | 08435 | 5 | 91565 | 26 |
| 35 | 7 23 20 | 4 36 40 | 9.75405 | 11 | 10.24595 | 9.83849 | 16 | 10.16151 | 10.08444 | 5 | 9.91556 | 25 |
| 36 | 23 12 | 36 48 | 75423 | 11 | 24577 | 83876 | 16 | 16124 | 08453 | 5 | 91547 | 24 |
| 37 | 23 4 | 36 56 | 75441 | 11 | 24559 | 83903 | 17 | 16097 | 08462 | 5 | 91538 | 23 |
| 38 | 22 56 | 37 4 | 75459 | 12 | 24541 | 83930 | 17 | 16070 | 08470 | 5 | 91530 | 22 |
| 39 | 22 48 | 37 12 | 75478 | 12 | 24522 | 83957 | 18 | 16043 | 08479 | 6 | 91521 | 21 |
| 40 | 7 22 40 | 4 37 20 | 9.75496 | 12 | 10.24504 | 9.83984 | 18 | 10.16016 | 10.08488 | 6 | 9.91512 | 20 |
| 41 | 22 32 | 37 28 | 75514 | 13 | 24486 | 84011 | 18 | 15989 | 08496 | 6 | 91504 | 19 |
| 42 | 22 24 | 37 36 | 75533 | 13 | 24467 | 84038 | 19 | 15962 | 08505 | 6 | 91495 | 18 |
| 43 | 22 16 | 37 44 | 75551 | 13 | 24449 | 84065 | 19 | 15935 | 08514 | 6 | 91486 | 17 |
| 44 | 22 8 | 37 52 | 75569 | 13 | 24431 | 84092 | 20 | 15908 | 08523 | 6 | 91477 | 16 |
| 45 | 7 22 0 | 4 38 0 | 9.75587 | 14 | 10.24413 | 9.84119 | 20 | 10.15881 | 10.08531 | 7 | 9.91469 | 15 |
| 46 | 21 52 | 38 8 | 75605 | 14 | 24395 | 84146 | 21 | 15854 | 08540 | 7 | 91460 | 14 |
| 47 | 21 44 | 38 16 | 75624 | 14 | 24376 | 84173 | 21 | 15827 | 08549 | 7 | 91451 | 13 |
| 48 | 21 36 | 38 24 | 75642 | 15 | 24358 | 84200 | 22 | 15800 | 08558 | 7 | 91442 | 12 |
| 49 | 21 28 | 38 32 | 75660 | 15 | 24340 | 84227 | 22 | 15773 | 08567 | 7 | 91433 | 11 |
| 50 | 7 21 20 | 4 38 40 | 9.75678 | 15 | 10.24322 | 9.84254 | 23 | 10.15746 | 10.08575 | 7 | 9.91425 | 10 |
| 51 | 21 12 | 38 48 | 75696 | 16 | 24304 | 84280 | 23 | 15720 | 08584 | 7 | 91416 | 9 |
| 52 | 21 4 | 38 56 | 75714 | 16 | 24286 | 84307 | 23 | 15693 | 08593 | 8 | 91407 | 8 |
| 53 | 20 56 | 39 4 | 75733 | 16 | 24267 | 84334 | 24 | 15666 | 08602 | 8 | 91398 | 7 |
| 54 | 20 48 | 39 12 | 75751 | 17 | 24249 | 84361 | 24 | 15639 | 08611 | 8 | 91389 | 6 |
| 55 | 7 20 40 | 4 39 20 | 9.75769 | 17 | 10.24231 | 9.84388 | 25 | 10.15612 | 10.08619 | 8 | 9.91381 | 5 |
| 56 | 20 32 | 39 28 | 75787 | 17 | 24213 | 84415 | 25 | 15585 | 08628 | 8 | 91372 | 4 |
| 57 | 20 24 | 39 36 | 75805 | 17 | 24195 | 84442 | 26 | 15558 | 08637 | 8 | 91363 | 3 |
| 58 | 20 16 | 39 44 | 75823 | 18 | 24177 | 84469 | 26 | 15531 | 08646 | 8 | 91354 | 2 |
| 59 | 20 8 | 39 52 | 75841 | 18 | 24159 | 84496 | 27 | 15504 | 08655 | 9 | 91345 | 1 |
| 60 | 20 0 | 40 0 | 75859 | 18 | 24141 | 84523 | 27 | 15477 | 08664 | 9 | 91336 | 0 |

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|-----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|------|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| M. | Hour A. M. | Hour P. M. | Sine | Diff. | Cosecant. | Tangent | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | Hour A. M. | Hour P. M. | Sine | Diff. | Cosecant. | Tangent | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
| 0 | 7 20 0 | 4 40 0 | 9. 75859 | 0 | 10. 24141 | 9. 84523 | 0 | 10. 15477 | 10. 08664 | 0 | 9. 91336 | 60 | | | | | | | | | | | | |
| 1 | 19 52 | 40 8 | 75877 | 0 | 24123 | 84550 | 0 | 15450 | 08672 | 0 | 91328 | 59 | | | | | | | | | | | | |
| 2 | 19 44 | 40 16 | 75895 | 1 | 24105 | 84576 | 1 | 15424 | 08681 | 0 | 91319 | 58 | | | | | | | | | | | | |
| 3 | 19 36 | 40 24 | 75913 | 1 | 24087 | 84603 | 1 | 15397 | 08690 | 0 | 91310 | 57 | | | | | | | | | | | | |
| 4 | 19 28 | 40 32 | 75931 | 1 | 24069 | 84630 | 2 | 15370 | 08699 | 1 | 91301 | 56 | | | | | | | | | | | | |
| 5 | 7 19 20 | 4 40 40 | 9. 75949 | 1 | 10. 24051 | 9. 84657 | 2 | 10. 15343 | 10. 08708 | 1 | 9. 91292 | 55 | | | | | | | | | | | | |
| 6 | 19 12 | 40 48 | 75967 | 2 | 24033 | 84684 | 3 | 15316 | 08717 | 1 | 91283 | 54 | | | | | | | | | | | | |
| 7 | 19 4 | 40 56 | 75985 | 2 | 24015 | 84711 | 3 | 15289 | 08726 | 1 | 91274 | 53 | | | | | | | | | | | | |
| 8 | 18 56 | 41 4 | 76003 | 2 | 23997 | 84738 | 4 | 15262 | 08734 | 1 | 91266 | 52 | | | | | | | | | | | | |
| 9 | 18 48 | 41 12 | 76021 | 3 | 23979 | 84764 | 4 | 15236 | 08743 | 1 | 91257 | 51 | | | | | | | | | | | | |
| 10 | 7 18 40 | 4 41 20 | 9. 76039 | 3 | 10. 23961 | 9. 84791 | 4 | 10. 15209 | 10. 08752 | 2 | 9. 91248 | 50 | | | | | | | | | | | | |
| 11 | 18 32 | 41 28 | 76057 | 3 | 23943 | 84818 | 5 | 15182 | 08761 | 2 | 91239 | 49 | | | | | | | | | | | | |
| 12 | 18 24 | 41 36 | 76075 | 4 | 23925 | 84845 | 5 | 15155 | 08770 | 2 | 91230 | 48 | | | | | | | | | | | | |
| 13 | 18 16 | 41 44 | 76093 | 4 | 23907 | 84872 | 6 | 15128 | 08779 | 2 | 91221 | 47 | | | | | | | | | | | | |
| 14 | 18 8 | 41 52 | 76111 | 4 | 23889 | 84899 | 6 | 15101 | 08788 | 2 | 91212 | 46 | | | | | | | | | | | | |
| 15 | 7 18 0 | 4 42 0 | 9. 76129 | 4 | 10. 23871 | 9. 84925 | 7 | 10. 15075 | 10. 08797 | 2 | 9. 91203 | 45 | | | | | | | | | | | | |
| 16 | 17 52 | 42 8 | 76146 | 5 | 23854 | 84952 | 7 | 15048 | 08806 | 3 | 91194 | 44 | | | | | | | | | | | | |
| 17 | 17 44 | 42 16 | 76164 | 5 | 23836 | 84979 | 8 | 15021 | 08815 | 3 | 91185 | 43 | | | | | | | | | | | | |
| 18 | 17 36 | 42 24 | 76182 | 5 | 23818 | 85006 | 8 | 14994 | 08824 | 3 | 91176 | 42 | | | | | | | | | | | | |
| 19 | 17 28 | 42 32 | 76200 | 6 | 23800 | 85033 | 8 | 14967 | 08833 | 3 | 91167 | 41 | | | | | | | | | | | | |
| 20 | 7 17 20 | 4 42 40 | 9. 76218 | 6 | 10. 23782 | 9. 85059 | 9 | 10. 14941 | 10. 08842 | 3 | 9. 91158 | 40 | | | | | | | | | | | | |
| 21 | 17 12 | 42 48 | 76236 | 6 | 23764 | 85086 | 9 | 14914 | 08851 | 3 | 91149 | 39 | | | | | | | | | | | | |
| 22 | 17 4 | 42 56 | 76253 | 6 | 23747 | 85113 | 10 | 14887 | 08859 | 3 | 91141 | 38 | | | | | | | | | | | | |
| 23 | 16 56 | 43 4 | 76271 | 7 | 23729 | 85140 | 10 | 14860 | 08868 | 3 | 91132 | 37 | | | | | | | | | | | | |
| 24 | 16 48 | 43 12 | 76289 | 7 | 23711 | 85166 | 11 | 14834 | 08877 | 4 | 91123 | 36 | | | | | | | | | | | | |
| 25 | 7 16 40 | 4 43 20 | 9. 76307 | 7 | 10. 23693 | 9. 85193 | 11 | 10. 14807 | 10. 08886 | 4 | 9. 91114 | 35 | | | | | | | | | | | | |
| 26 | 16 32 | 43 28 | 76324 | 8 | 23676 | 85220 | 12 | 14780 | 08895 | 4 | 91105 | 34 | | | | | | | | | | | | |
| 27 | 16 24 | 43 36 | 76342 | 8 | 23658 | 85247 | 12 | 14753 | 08904 | 4 | 91096 | 33 | | | | | | | | | | | | |
| 28 | 16 16 | 43 44 | 76360 | 8 | 23640 | 85273 | 12 | 14727 | 08913 | 4 | 91087 | 32 | | | | | | | | | | | | |
| 29 | 16 8 | 43 52 | 76378 | 9 | 23622 | 85300 | 13 | 14700 | 08922 | 4 | 91078 | 31 | | | | | | | | | | | | |
| 30 | 7 16 0 | 4 44 0 | 9. 76395 | 9 | 10. 23605 | 9. 85327 | 13 | 10. 14673 | 10. 08931 | 5 | 9. 91069 | 30 | | | | | | | | | | | | |
| 31 | 15 52 | 44 8 | 76413 | 9 | 23587 | 85354 | 14 | 14646 | 08940 | 5 | 91060 | 29 | | | | | | | | | | | | |
| 32 | 15 44 | 44 16 | 76431 | 9 | 23569 | 85380 | 14 | 14620 | 08949 | 5 | 91051 | 28 | | | | | | | | | | | | |
| 33 | 15 36 | 44 24 | 76448 | 10 | 23552 | 85407 | 15 | 14593 | 08958 | 5 | 91042 | 27 | | | | | | | | | | | | |
| 34 | 15 28 | 44 32 | 76466 | 10 | 23534 | 85434 | 15 | 14566 | 08967 | 5 | 91033 | 26 | | | | | | | | | | | | |
| 35 | 7 15 20 | 4 44 40 | 9. 76484 | 10 | 10. 23516 | 9. 85460 | 16 | 10. 14540 | 10. 08977 | 5 | 9. 91023 | 25 | | | | | | | | | | | | |
| 36 | 15 12 | 44 48 | 76501 | 11 | 23499 | 85487 | 16 | 14513 | 08986 | 5 | 91014 | 24 | | | | | | | | | | | | |
| 37 | 15 4 | 44 56 | 76519 | 11 | 23481 | 85514 | 16 | 14486 | 08995 | 6 | 91005 | 23 | | | | | | | | | | | | |
| 38 | 14 56 | 45 4 | 76537 | 11 | 23463 | 85540 | 17 | 14460 | 09004 | 6 | 90996 | 22 | | | | | | | | | | | | |
| 39 | 14 48 | 45 12 | 76554 | 12 | 23446 | 85567 | 17 | 14433 | 09013 | 6 | 90987 | 21 | | | | | | | | | | | | |
| 40 | 7 14 40 | 4 45 20 | 9. 76572 | 12 | 10. 23428 | 9. 85594 | 18 | 10. 14406 | 10. 09022 | 6 | 9. 90978 | 20 | | | | | | | | | | | | |
| 41 | 14 32 | 45 28 | 76590 | 12 | 23410 | 85620 | 18 | 14380 | 09031 | 6 | 90969 | 19 | | | | | | | | | | | | |
| 42 | 14 24 | 45 36 | 76607 | 12 | 23393 | 85647 | 19 | 14353 | 09040 | 6 | 90960 | 18 | | | | | | | | | | | | |
| 43 | 14 16 | 45 44 | 76625 | 13 | 23375 | 85674 | 19 | 14326 | 09049 | 6 | 90951 | 17 | | | | | | | | | | | | |
| 44 | 14 8 | 45 52 | 76642 | 13 | 23358 | 85700 | 20 | 14300 | 09058 | 7 | 90942 | 16 | | | | | | | | | | | | |
| 45 | 7 14 0 | 4 46 0 | 9. 76660 | 13 | 10. 23340 | 9. 85727 | 20 | 10. 14273 | 10. 09067 | 7 | 9. 90933 | 15 | | | | | | | | | | | | |
| 46 | 13 52 | 46 8 | 76677 | 14 | 23323 | 85754 | 20 | 14246 | 09076 | 7 | 90924 | 14 | | | | | | | | | | | | |
| 47 | 13 44 | 46 16 | 76695 | 14 | 23305 | 85780 | 21 | 14220 | 09085 | 7 | 90915 | 13 | | | | | | | | | | | | |
| 48 | 13 36 | 46 24 | 76712 | 14 | 23288 | 85807 | 21 | 14193 | 09094 | 7 | 90906 | 12 | | | | | | | | | | | | |
| 49 | 13 28 | 46 32 | 76730 | 14 | 23270 | 85834 | 22 | 14166 | 09104 | 7 | 90896 | 11 | | | | | | | | | | | | |
| 50 | 7 13 20 | 4 46 40 | 9. 76747 | 15 | 10. 23253 | 9. 85860 | 22 | 10. 14140 | 10. 09113 | 8 | 9. 90887 | 10 | | | | | | | | | | | | |
| 51 | 13 12 | 46 48 | 76765 | 15 | 23235 | 85887 | 23 | 14113 | 09122 | 8 | 90878 | 9 | | | | | | | | | | | | |
| 52 | 13 4 | 46 56 | 76782 | 15 | 23218 | 85913 | 23 | 14087 | 09131 | 8 | 90869 | 8 | | | | | | | | | | | | |
| 53 | 12 56 | 47 4 | 76800 | 16 | 23200 | 85940 | 24 | 14060 | 09140 | 8 | 90860 | 7 | | | | | | | | | | | | |
| 54 | 12 48 | 47 12 | 76817 | 16 | 23183 | 85967 | 24 | 14033 | 09149 | 8 | 90851 | 6 | | | | | | | | | | | | |
| 55 | 7 12 40 | 4 47 20 | 9. 76835 | 16 | 10. 23165 | 9. 85993 | 24 | 10. 14007 | 10. 09158 | 8 | 9. 90842 | 5 | | | | | | | | | | | | |
| 56 | 12 32 | 47 28 | 76852 | 17 | 23148 | 86020 | 25 | 13980 | 09168 | 8 | 90832 | 4 | | | | | | | | | | | | |
| 57 | 12 24 | 47 36 | 76870 | 17 | 23130 | 86046 | 25 | 13954 | 09177 | 9 | 90823 | 3 | | | | | | | | | | | | |
| 58 | 12 16 | 47 44 | 76887 | 17 | 23113 | 86073 | 26 | 13927 | 09186 | 9 | 90814 | 2 | | | | | | | | | | | | |
| 59 | 12 8 | 47 52 | 76904 | 17 | 23096 | 86100 | 26 | 13900 | 09195 | 9 | 90805 | 1 | | | | | | | | | | | | |
| 60 | 12 0 | 48 0 | 76922 | 18 | 23078 | 86126 | 27 | 13874 | 09204 | 9 | 90796 | 0 | | | | | | | | | | | | |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 7 12 0 | 4 48 0 | 9.76922 | 0 | 10.23078 | 9.86126 | 0 | 10.13874 | 10.09204 | 0 | 9.90796 | 60 |
| 1 | 11 52 | 48 8 | 76939 | 0 | 23061 | 86153 | 0 | 13847 | 09213 | 0 | 90787 | 59 |
| 2 | 11 44 | 48 16 | 76957 | 1 | 23043 | 86179 | 1 | 13821 | 09223 | 0 | 90777 | 58 |
| 3 | 11 36 | 48 24 | 76974 | 1 | 23026 | 86206 | 1 | 13794 | 09232 | 0 | 90768 | 57 |
| 4 | 11 28 | 48 32 | 76991 | 1 | 23009 | 86232 | 2 | 13768 | 09241 | 1 | 90759 | 56 |
| 5 | 7 11 20 | 4 48 40 | 9.77009 | 1 | 10.22991 | 9.86259 | 2 | 10.13741 | 10.09250 | 1 | 9.90750 | 55 |
| 6 | 11 12 | 48 48 | 77026 | 2 | 22974 | 86285 | 3 | 13715 | 09259 | 1 | 90741 | 54 |
| 7 | 11 4 | 48 56 | 77043 | 2 | 22957 | 86312 | 3 | 13688 | 09269 | 1 | 90731 | 53 |
| 8 | 10 56 | 49 4 | 77061 | 2 | 22939 | 86338 | 4 | 13662 | 09278 | 1 | 90722 | 52 |
| 9 | 10 48 | 49 12 | 77078 | 3 | 22922 | 86365 | 4 | 13635 | 09287 | 1 | 90713 | 51 |
| 10 | 7 10 40 | 4 49 20 | 9.77095 | 3 | 10.22905 | 9.86392 | 4 | 10.13608 | 10.09296 | 2 | 9.90704 | 50 |
| 11 | 10 32 | 49 28 | 77112 | 3 | 22888 | 86418 | 5 | 13582 | 09306 | 2 | 90694 | 49 |
| 12 | 10 24 | 49 36 | 77130 | 3 | 22870 | 86445 | 5 | 13555 | 09315 | 2 | 90685 | 48 |
| 13 | 10 16 | 49 44 | 77147 | 4 | 22853 | 86471 | 6 | 13529 | 09324 | 2 | 90676 | 47 |
| 14 | 10 8 | 49 52 | 77164 | 4 | 22836 | 86498 | 6 | 13502 | 09333 | 2 | 90667 | 46 |
| 15 | 7 10 0 | 4 50 0 | 9.77181 | 4 | 10.22819 | 9.86524 | 7 | 10.13476 | 10.09343 | 2 | 9.90657 | 45 |
| 16 | 9 52 | 50 8 | 77199 | 5 | 22801 | 86551 | 7 | 13449 | 09352 | 2 | 90648 | 44 |
| 17 | 9 44 | 50 16 | 77216 | 5 | 22784 | 86577 | 7 | 13423 | 09361 | 3 | 90639 | 43 |
| 18 | 9 36 | 50 24 | 77233 | 5 | 22767 | 86603 | 8 | 13397 | 09370 | 3 | 90630 | 42 |
| 19 | 9 28 | 50 32 | 77250 | 5 | 22750 | 86630 | 8 | 13370 | 09380 | 3 | 90620 | 41 |
| 20 | 7 9 20 | 4 50 40 | 9.77268 | 6 | 10.22732 | 9.86656 | 9 | 10.13344 | 10.09389 | 3 | 9.90611 | 40 |
| 21 | 9 12 | 50 48 | 77285 | 6 | 22715 | 86683 | 9 | 13317 | 09398 | 3 | 90602 | 39 |
| 22 | 9 4 | 50 56 | 77302 | 6 | 22698 | 86709 | 10 | 13291 | 09408 | 3 | 90592 | 38 |
| 23 | 8 56 | 51 4 | 77319 | 7 | 22681 | 86736 | 10 | 13264 | 09417 | 4 | 90583 | 37 |
| 24 | 8 48 | 51 12 | 77336 | 7 | 22664 | 86762 | 11 | 13238 | 09426 | 4 | 90574 | 36 |
| 25 | 7 8 40 | 4 51 20 | 9.77353 | 7 | 10.22647 | 9.86789 | 11 | 10.13211 | 10.09435 | 4 | 9.90565 | 35 |
| 26 | 8 32 | 51 28 | 77370 | 7 | 22630 | 86815 | 11 | 13185 | 09445 | 4 | 90555 | 34 |
| 27 | 8 24 | 51 36 | 77387 | 8 | 22613 | 86842 | 12 | 13158 | 09454 | 4 | 90546 | 33 |
| 28 | 8 16 | 51 44 | 77405 | 8 | 22595 | 86868 | 12 | 13132 | 09463 | 4 | 90537 | 32 |
| 29 | 8 8 | 51 52 | 77422 | 8 | 22578 | 86894 | 13 | 13106 | 09473 | 5 | 90527 | 31 |
| 30 | 7 8 0 | 4 52 0 | 9.77439 | 9 | 10.22561 | 9.86921 | 13 | 10.13079 | 10.09482 | 5 | 9.90518 | 30 |
| 31 | 7 52 | 52 8 | 77456 | 9 | 22544 | 86947 | 14 | 13053 | 09491 | 5 | 90509 | 29 |
| 32 | 7 44 | 52 16 | 77473 | 9 | 22527 | 86974 | 14 | 13026 | 09501 | 5 | 90499 | 28 |
| 33 | 7 36 | 52 24 | 77490 | 9 | 22510 | 87000 | 15 | 13000 | 09510 | 5 | 90490 | 27 |
| 34 | 7 28 | 52 32 | 77507 | 10 | 22493 | 87027 | 15 | 12973 | 09520 | 5 | 90480 | 26 |
| 35 | 7 20 | 4 52 40 | 9.77524 | 10 | 10.22476 | 9.87053 | 15 | 10.12947 | 10.09529 | 5 | 9.90471 | 25 |
| 36 | 7 12 | 52 48 | 77541 | 10 | 22459 | 87079 | 16 | 12921 | 09538 | 6 | 90462 | 24 |
| 37 | 7 4 | 52 56 | 77558 | 11 | 22442 | 87106 | 16 | 12894 | 09548 | 6 | 90452 | 23 |
| 38 | 6 56 | 53 4 | 77575 | 11 | 22425 | 87132 | 17 | 12868 | 09557 | 6 | 90443 | 22 |
| 39 | 6 48 | 53 12 | 77592 | 11 | 22408 | 87158 | 17 | 12842 | 09566 | 6 | 90434 | 21 |
| 40 | 7 6 40 | 4 53 20 | 9.77609 | 11 | 10.22391 | 9.87185 | 18 | 10.12815 | 10.09576 | 6 | 9.90424 | 20 |
| 41 | 6 32 | 53 28 | 77626 | 12 | 22374 | 87211 | 18 | 12789 | 09585 | 6 | 90415 | 19 |
| 42 | 6 24 | 53 36 | 77643 | 12 | 22357 | 87238 | 18 | 12762 | 09595 | 7 | 90405 | 18 |
| 43 | 6 16 | 53 44 | 77660 | 12 | 22340 | 87264 | 19 | 12736 | 09604 | 7 | 90396 | 17 |
| 44 | 6 8 | 53 52 | 77677 | 13 | 22323 | 87290 | 19 | 12710 | 09614 | 7 | 90386 | 16 |
| 45 | 7 6 0 | 4 54 0 | 9.77694 | 13 | 10.22306 | 9.87317 | 20 | 10.12683 | 10.09623 | 7 | 9.90377 | 15 |
| 46 | 5 52 | 54 8 | 77711 | 13 | 22289 | 87343 | 20 | 12657 | 09632 | 7 | 90368 | 14 |
| 47 | 5 44 | 54 16 | 77728 | 13 | 22272 | 87369 | 21 | 12631 | 09642 | 7 | 90358 | 13 |
| 48 | 5 36 | 54 24 | 77744 | 14 | 22256 | 87396 | 21 | 12604 | 09651 | 7 | 90349 | 12 |
| 49 | 5 28 | 54 32 | 77761 | 14 | 22239 | 87422 | 22 | 12578 | 09661 | 8 | 90339 | 11 |
| 50 | 7 5 20 | 4 54 40 | 9.77778 | 14 | 10.22222 | 9.87448 | 22 | 10.12552 | 10.09670 | 8 | 9.90330 | 10 |
| 51 | 5 12 | 54 48 | 77795 | 15 | 22205 | 87475 | 22 | 12525 | 09680 | 8 | 90320 | 9 |
| 52 | 5 4 | 54 56 | 77812 | 15 | 22188 | 87501 | 23 | 12499 | 09689 | 8 | 90311 | 8 |
| 53 | 4 56 | 55 4 | 77829 | 15 | 22171 | 87527 | 23 | 12473 | 09699 | 8 | 90301 | 7 |
| 54 | 4 48 | 55 12 | 77846 | 15 | 22154 | 87554 | 24 | 12446 | 09708 | 8 | 90292 | 6 |
| 55 | 7 4 40 | 4 55 20 | 9.77862 | 16 | 10.22138 | 9.87580 | 24 | 10.12420 | 10.09718 | 9 | 9.90282 | 5 |
| 56 | 4 32 | 55 28 | 77879 | 16 | 22121 | 87606 | 25 | 12394 | 09727 | 9 | 90273 | 4 |
| 57 | 4 24 | 55 36 | 77896 | 16 | 22104 | 87633 | 25 | 12367 | 09737 | 9 | 90263 | 3 |
| 58 | 4 16 | 55 44 | 77913 | 16 | 22087 | 87659 | 26 | 12341 | 09746 | 9 | 90254 | 2 |
| 59 | 4 8 | 55 52 | 77930 | 17 | 22070 | 87685 | 26 | 12315 | 09756 | 9 | 90244 | 1 |
| 60 | 4 0 | 56 0 | 77946 | 17 | 22054 | 87711 | 26 | 12289 | 09765 | 9 | 90235 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

| 37° | | | | | | | | | | | | 112° | |
|-----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|------|--|
| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. | |
| 0 | 7 4 0 | 4 56 0 | 9. 77946 | 0 | 10. 22054 | 9. 87711 | 0 | 10. 12289 | 10. 09765 | 0 | 9. 90235 | 60 | |
| 1 | 3 52 | 56 8 | 77963 | 0 | 22037 | 87738 | 0 | 12262 | 09775 | 0 | 90225 | 59 | |
| 2 | 3 44 | 56 16 | 77980 | 1 | 22020 | 87764 | 1 | 12236 | 09784 | 0 | 90216 | 58 | |
| 3 | 3 36 | 56 24 | 77997 | 1 | 22003 | 87790 | 1 | 12210 | 09794 | 0 | 90206 | 57 | |
| 4 | 3 28 | 56 32 | 78013 | 1 | 21987 | 87817 | 2 | 12183 | 09803 | 1 | 90197 | 56 | |
| 5 | 7 3 20 | 4 56 40 | 9. 78030 | 1 | 10. 21970 | 9. 87843 | 2 | 10. 12157 | 10. 09813 | 1 | 9. 90187 | 55 | |
| 6 | 3 12 | 56 48 | 78047 | 2 | 21953 | 87869 | 3 | 12131 | 09822 | 1 | 90178 | 54 | |
| 7 | 3 4 | 56 56 | 78063 | 2 | 21937 | 87895 | 3 | 12105 | 09832 | 1 | 90168 | 53 | |
| 8 | 2 56 | 57 4 | 78080 | 2 | 21920 | 87922 | 3 | 12078 | 09841 | 1 | 90159 | 52 | |
| 9 | 2 48 | 57 12 | 78097 | 2 | 21903 | 87948 | 4 | 12052 | 09851 | 1 | 90149 | 51 | |
| 10 | 7 2 40 | 4 57 20 | 9. 78113 | 3 | 10. 21887 | 9. 87974 | 4 | 10. 12026 | 10. 09861 | 2 | 9. 90139 | 50 | |
| 11 | 2 32 | 57 28 | 78130 | 3 | 21870 | 88000 | 5 | 12000 | 09870 | 2 | 90130 | 49 | |
| 12 | 2 24 | 57 36 | 78147 | 3 | 21853 | 88027 | 5 | 11973 | 09880 | 2 | 90120 | 48 | |
| 13 | 2 16 | 57 44 | 78163 | 4 | 21837 | 88053 | 6 | 11947 | 09889 | 2 | 90111 | 47 | |
| 14 | 2 8 | 57 52 | 78180 | 4 | 21820 | 88079 | 6 | 11921 | 09899 | 2 | 90101 | 46 | |
| 15 | 7 2 0 | 4 58 0 | 9. 78197 | 4 | 10. 21803 | 9. 88105 | 7 | 10. 11895 | 10. 09909 | 2 | 9. 90091 | 45 | |
| 16 | 1 52 | 58 8 | 78213 | 4 | 21787 | 88131 | 7 | 11869 | 09918 | 3 | 90082 | 44 | |
| 17 | 1 44 | 58 16 | 78230 | 5 | 21770 | 88158 | 7 | 11842 | 09928 | 3 | 90072 | 43 | |
| 18 | 1 36 | 58 24 | 78246 | 5 | 21754 | 88184 | 8 | 11816 | 09937 | 3 | 90063 | 42 | |
| 19 | 1 28 | 58 32 | 78263 | 5 | 21737 | 88210 | 8 | 11790 | 09947 | 3 | 90053 | 41 | |
| 20 | 7 1 20 | 4 58 40 | 9. 78280 | 5 | 10. 21720 | 9. 88236 | 9 | 10. 11764 | 10. 09957 | 3 | 9. 90043 | 40 | |
| 21 | 1 12 | 58 48 | 78296 | 6 | 21704 | 88262 | 9 | 11738 | 09966 | 3 | 90034 | 39 | |
| 22 | 1 4 | 58 56 | 78313 | 6 | 21687 | 88289 | 10 | 11711 | 09976 | 4 | 90024 | 38 | |
| 23 | 0 56 | 59 4 | 78329 | 6 | 21671 | 88315 | 10 | 11685 | 09986 | 4 | 90014 | 37 | |
| 24 | 0 48 | 59 12 | 78346 | 7 | 21654 | 88341 | 10 | 11659 | 09995 | 4 | 90005 | 36 | |
| 25 | 7 0 40 | 4 59 20 | 9. 78362 | 7 | 10. 21638 | 9. 88367 | 11 | 10. 11633 | 10. 10005 | 4 | 9. 89995 | 35 | |
| 26 | 0 32 | 59 28 | 78379 | 7 | 21621 | 88393 | 11 | 11607 | 10015 | 4 | 89985 | 34 | |
| 27 | 0 24 | 59 36 | 78395 | 7 | 21605 | 88420 | 12 | 11580 | 10024 | 4 | 89976 | 33 | |
| 28 | 0 16 | 59 44 | 78412 | 8 | 21588 | 88446 | 12 | 11554 | 10034 | 5 | 89966 | 32 | |
| 29 | 0 8 | 59 52 | 78428 | 8 | 21572 | 88472 | 13 | 11528 | 10044 | 5 | 89956 | 31 | |
| 30 | 7 0 0 | 5 0 0 | 9. 78445 | 8 | 10. 21555 | 9. 88498 | 13 | 10. 11502 | 10. 10053 | 5 | 9. 89947 | 30 | |
| 31 | 6 59 52 | 0 8 | 78461 | 9 | 21539 | 88524 | 14 | 11476 | 10063 | 5 | 89937 | 29 | |
| 32 | 59 44 | 0 16 | 78478 | 9 | 21522 | 88550 | 14 | 11450 | 10073 | 5 | 89927 | 28 | |
| 33 | 59 36 | 0 24 | 78494 | 9 | 21506 | 88577 | 14 | 11423 | 10082 | 5 | 89918 | 27 | |
| 34 | 59 28 | 0 32 | 78510 | 9 | 21490 | 88603 | 15 | 11397 | 10092 | 5 | 89908 | 26 | |
| 35 | 6 59 20 | 5 0 40 | 9. 78527 | 10 | 10. 21473 | 9. 88629 | 15 | 10. 11371 | 10. 10102 | 6 | 9. 89898 | 25 | |
| 36 | 59 12 | 0 48 | 78543 | 10 | 21457 | 88655 | 16 | 11345 | 10112 | 6 | 89888 | 24 | |
| 37 | 59 4 | 0 56 | 78560 | 10 | 21440 | 88681 | 16 | 11319 | 10121 | 6 | 89879 | 23 | |
| 38 | 58 56 | 1 4 | 78576 | 10 | 21424 | 88707 | 17 | 11293 | 10131 | 6 | 89869 | 22 | |
| 39 | 58 48 | 1 12 | 78592 | 11 | 21408 | 88733 | 17 | 11267 | 10141 | 6 | 89859 | 21 | |
| 40 | 6 58 40 | 5 1 20 | 9. 78609 | 11 | 10. 21391 | 9. 88759 | 17 | 10. 11241 | 10. 10151 | 6 | 9. 89849 | 20 | |
| 41 | 58 32 | 1 28 | 78625 | 11 | 21375 | 88786 | 18 | 11214 | 10160 | 7 | 89840 | 19 | |
| 42 | 58 24 | 1 36 | 78642 | 12 | 21358 | 88812 | 18 | 11188 | 10170 | 7 | 89830 | 18 | |
| 43 | 58 16 | 1 44 | 78658 | 12 | 21342 | 88838 | 19 | 11162 | 10180 | 7 | 89820 | 17 | |
| 44 | 58 8 | 1 52 | 78674 | 12 | 21326 | 88864 | 19 | 11136 | 10190 | 7 | 89810 | 16 | |
| 45 | 6 58 0 | 5 2 0 | 9. 78691 | 12 | 10. 21309 | 9. 88890 | 20 | 10. 11110 | 10. 10199 | 7 | 9. 89801 | 15 | |
| 46 | 57 52 | 2 8 | 78707 | 13 | 21293 | 88916 | 20 | 11084 | 10209 | 7 | 89791 | 14 | |
| 47 | 57 44 | 2 16 | 78723 | 13 | 21277 | 88942 | 20 | 11058 | 10219 | 8 | 89781 | 13 | |
| 48 | 57 36 | 2 24 | 78739 | 13 | 21261 | 88968 | 21 | 11032 | 10229 | 8 | 89771 | 12 | |
| 49 | 57 28 | 2 32 | 78756 | 13 | 21244 | 88994 | 21 | 11006 | 10239 | 8 | 89761 | 11 | |
| 50 | 6 57 20 | 5 2 40 | 9. 78772 | 14 | 10. 21228 | 9. 89020 | 22 | 10. 10980 | 10. 10248 | 8 | 9. 89752 | 10 | |
| 51 | 57 12 | 2 48 | 78788 | 14 | 21212 | 89046 | 22 | 10954 | 10258 | 8 | 89742 | 9 | |
| 52 | 57 4 | 2 56 | 78805 | 14 | 21195 | 89073 | 23 | 10927 | 10268 | 8 | 89732 | 8 | |
| 53 | 56 56 | 3 4 | 78821 | 15 | 21179 | 89099 | 23 | 10901 | 10278 | 9 | 89722 | 7 | |
| 54 | 56 48 | 3 12 | 78837 | 15 | 21163 | 89125 | 24 | 10875 | 10288 | 9 | 89712 | 6 | |
| 55 | 6 56 40 | 5 3 20 | 9. 78853 | 15 | 10. 21147 | 9. 89151 | 24 | 10. 10849 | 10. 10298 | 9 | 9. 89702 | 5 | |
| 56 | 56 32 | 3 28 | 78869 | 15 | 21131 | 89177 | 24 | 10823 | 10307 | 9 | 89693 | 4 | |
| 57 | 56 24 | 3 36 | 78886 | 16 | 21114 | 89203 | 25 | 10797 | 10317 | 9 | 89683 | 3 | |
| 58 | 56 16 | 3 44 | 78902 | 16 | 21098 | 89229 | 25 | 10771 | 10327 | 9 | 89673 | 2 | |
| 59 | 56 8 | 3 52 | 78918 | 16 | 21082 | 89255 | 26 | 10745 | 10337 | 10 | 89663 | 1 | |
| 60 | 56 0 | 4 0 | 78934 | 16 | 21066 | 89281 | 26 | 10719 | 10347 | 10 | 89653 | 0 | |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. | |

SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 6 56 0 | 5 4 0 | 9. 78934 | 0 | 10. 21066 | 9. 89281 | 0 | 10. 10719 | 10. 10347 | 0 | 9. 89653 | 60 |
| 1 | 55 52 | 4 8 | 78950 | 0 | 21050 | 89307 | 0 | 10693 | 10357 | 0 | 89643 | 59 |
| 2 | 55 44 | 4 16 | 78967 | 1 | 21033 | 89333 | 1 | 10667 | 10376 | 0 | 89633 | 58 |
| 3 | 55 36 | 4 24 | 78983 | 1 | 21017 | 89359 | 1 | 10641 | 10376 | 1 | 89624 | 57 |
| 4 | 55 28 | 4 32 | 78999 | 1 | 21001 | 89385 | 2 | 10615 | 10386 | 1 | 89614 | 56 |
| 5 | 6 55 20 | 5 4 40 | 9. 79015 | 1 | 10. 20985 | 9. 89411 | 2 | 10. 10589 | 10. 10396 | 1 | 9. 89604 | 55 |
| 6 | 55 12 | 4 48 | 79031 | 2 | 20969 | 89437 | 3 | 10563 | 10406 | 1 | 89594 | 54 |
| 7 | 55 4 | 4 56 | 79047 | 2 | 20953 | 89463 | 3 | 10537 | 10416 | 1 | 89584 | 53 |
| 8 | 54 56 | 5 4 | 79063 | 2 | 20937 | 89489 | 3 | 10511 | 10426 | 1 | 89574 | 52 |
| 9 | 54 48 | 5 12 | 79079 | 2 | 20921 | 89515 | 4 | 10485 | 10436 | 2 | 89564 | 51 |
| 10 | 6 54 40 | 5 5 20 | 9. 79095 | 3 | 10. 20905 | 9. 89541 | 4 | 10. 10459 | 10. 10446 | 2 | 9. 89554 | 50 |
| 11 | 54 32 | 5 28 | 79111 | 3 | 20889 | 89567 | 5 | 10433 | 10456 | 2 | 89544 | 49 |
| 12 | 54 24 | 5 36 | 79128 | 3 | 20872 | 89593 | 5 | 10407 | 10466 | 2 | 89534 | 48 |
| 13 | 54 16 | 5 44 | 79144 | 3 | 20856 | 89619 | 6 | 10381 | 10476 | 2 | 89524 | 47 |
| 14 | 54 8 | 5 52 | 79160 | 4 | 20840 | 89645 | 6 | 10355 | 10486 | 2 | 89514 | 46 |
| 15 | 6 54 0 | 5 6 0 | 9. 79176 | 4 | 10. 20824 | 9. 89671 | 6 | 10. 10329 | 10. 10496 | 3 | 9. 89504 | 45 |
| 16 | 53 52 | 6 8 | 79192 | 4 | 20808 | 89697 | 7 | 10303 | 10505 | 3 | 89495 | 44 |
| 17 | 53 44 | 6 16 | 79208 | 5 | 20792 | 89723 | 7 | 10277 | 10515 | 3 | 89485 | 43 |
| 18 | 53 36 | 6 24 | 79224 | 5 | 20776 | 89749 | 8 | 10251 | 10525 | 3 | 89475 | 42 |
| 19 | 53 28 | 6 32 | 79240 | 5 | 20760 | 89775 | 8 | 10225 | 10535 | 3 | 89465 | 41 |
| 20 | 6 53 20 | 5 6 40 | 9. 79256 | 5 | 10. 20744 | 9. 89801 | 9 | 10. 10199 | 10. 10545 | 3 | 9. 89455 | 40 |
| 21 | 53 12 | 6 48 | 79272 | 6 | 20728 | 89827 | 9 | 10173 | 10555 | 4 | 89445 | 39 |
| 22 | 53 4 | 6 56 | 79288 | 6 | 20712 | 89853 | 10 | 10147 | 10565 | 4 | 89435 | 38 |
| 23 | 52 56 | 7 4 | 79304 | 6 | 20696 | 89879 | 10 | 10121 | 10575 | 4 | 89425 | 37 |
| 24 | 52 48 | 7 12 | 79319 | 6 | 20681 | 89905 | 10 | 10095 | 10585 | 4 | 89415 | 36 |
| 25 | 6 52 40 | 5 7 20 | 9. 79335 | 7 | 10. 20665 | 9. 89931 | 11 | 10. 10069 | 10. 10595 | 4 | 9. 89405 | 35 |
| 26 | 52 32 | 7 28 | 79351 | 7 | 20649 | 89957 | 11 | 10043 | 10605 | 4 | 89395 | 34 |
| 27 | 52 24 | 7 36 | 79367 | 7 | 20633 | 89983 | 12 | 10017 | 10615 | 5 | 89385 | 33 |
| 28 | 52 16 | 7 44 | 79383 | 7 | 20617 | 90009 | 12 | 9991 | 10625 | 5 | 89375 | 32 |
| 29 | 52 8 | 7 52 | 79399 | 8 | 20601 | 90035 | 13 | 9965 | 10636 | 5 | 89365 | 31 |
| 30 | 6 52 0 | 5 8 0 | 9. 79415 | 8 | 10. 20585 | 9. 90061 | 13 | 10. 9939 | 10. 10646 | 5 | 9. 89355 | 30 |
| 31 | 51 52 | 8 8 | 79431 | 8 | 20569 | 90086 | 13 | 9914 | 10656 | 5 | 89344 | 29 |
| 32 | 51 44 | 8 16 | 79447 | 8 | 20553 | 90112 | 14 | 9888 | 10666 | 5 | 89334 | 28 |
| 33 | 51 36 | 8 24 | 79463 | 9 | 20537 | 90138 | 14 | 9862 | 10676 | 6 | 89324 | 27 |
| 34 | 51 28 | 8 32 | 79478 | 9 | 20522 | 90164 | 15 | 9836 | 10686 | 6 | 89314 | 26 |
| 35 | 6 51 20 | 5 8 40 | 9. 79494 | 9 | 10. 20506 | 9. 90190 | 15 | 10. 9810 | 10. 10696 | 6 | 9. 89304 | 25 |
| 36 | 51 12 | 8 48 | 79510 | 10 | 20490 | 90216 | 16 | 9784 | 10706 | 6 | 89294 | 24 |
| 37 | 51 4 | 8 56 | 79526 | 10 | 20474 | 90242 | 16 | 9758 | 10716 | 6 | 89284 | 23 |
| 38 | 50 56 | 9 4 | 79542 | 10 | 20458 | 90268 | 16 | 9732 | 10726 | 6 | 89274 | 22 |
| 39 | 50 48 | 9 12 | 79558 | 10 | 20442 | 90294 | 17 | 9706 | 10736 | 7 | 89264 | 21 |
| 40 | 6 50 40 | 5 9 20 | 9. 79573 | 11 | 10. 20427 | 9. 90320 | 17 | 10. 9680 | 10. 10746 | 7 | 9. 89254 | 20 |
| 41 | 50 32 | 9 28 | 79589 | 11 | 20411 | 90346 | 18 | 9654 | 10756 | 7 | 89244 | 19 |
| 42 | 50 24 | 9 36 | 79605 | 11 | 20395 | 90371 | 18 | 9629 | 10767 | 7 | 89233 | 18 |
| 43 | 50 16 | 9 44 | 79621 | 11 | 20379 | 90397 | 19 | 9603 | 10777 | 7 | 89223 | 17 |
| 44 | 50 8 | 9 52 | 79636 | 12 | 20364 | 90423 | 19 | 9577 | 10787 | 7 | 89213 | 16 |
| 45 | 6 50 0 | 5 10 0 | 9. 79652 | 12 | 10. 20348 | 9. 90449 | 19 | 10. 9551 | 10. 10797 | 8 | 9. 89203 | 15 |
| 46 | 49 52 | 10 8 | 79668 | 12 | 20332 | 90475 | 20 | 9525 | 10807 | 8 | 89193 | 14 |
| 47 | 49 44 | 10 16 | 79684 | 12 | 20316 | 90501 | 20 | 9499 | 10817 | 8 | 89183 | 13 |
| 48 | 49 36 | 10 24 | 79699 | 13 | 20301 | 90527 | 21 | 9473 | 10827 | 8 | 89173 | 12 |
| 49 | 49 28 | 10 32 | 79715 | 13 | 20285 | 90553 | 21 | 9447 | 10838 | 8 | 89162 | 11 |
| 50 | 6 49 20 | 5 10 40 | 9. 79731 | 13 | 10. 20269 | 9. 90578 | 22 | 10. 9422 | 10. 10848 | 8 | 9. 89152 | 10 |
| 51 | 49 12 | 10 48 | 79746 | 14 | 20254 | 90604 | 22 | 9396 | 10858 | 9 | 89142 | 9 |
| 52 | 49 4 | 10 56 | 79762 | 14 | 20238 | 90630 | 22 | 9370 | 10868 | 9 | 89132 | 8 |
| 53 | 48 56 | 11 4 | 79778 | 14 | 20222 | 90656 | 23 | 9344 | 10878 | 9 | 89122 | 7 |
| 54 | 48 48 | 11 12 | 79793 | 14 | 20207 | 90682 | 23 | 9318 | 10888 | 9 | 89112 | 6 |
| 55 | 6 48 40 | 5 11 20 | 9. 79809 | 15 | 10. 20191 | 9. 90708 | 24 | 10. 9292 | 10. 10899 | 9 | 9. 89101 | 5 |
| 56 | 48 32 | 11 28 | 79825 | 15 | 20175 | 90734 | 24 | 9266 | 10909 | 9 | 89091 | 4 |
| 57 | 48 24 | 11 36 | 79840 | 15 | 20160 | 90759 | 25 | 9241 | 10919 | 10 | 89081 | 3 |
| 58 | 48 16 | 11 44 | 79856 | 15 | 20144 | 90785 | 25 | 9215 | 10929 | 10 | 89071 | 2 |
| 59 | 48 8 | 11 52 | 79872 | 16 | 20128 | 90811 | 26 | 9189 | 10940 | 10 | 89060 | 1 |
| 60 | 48 0 | 12 0 | 79887 | 16 | 20113 | 90837 | 26 | 9163 | 10950 | 10 | 89050 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 6 48 0 | 5 12 0 | 9. 79887 | 0 | 10. 20113 | 9. 90837 | 0 | 10. 09163 | 10. 10950 | 0 | 9. 89050 | 60 |
| 1 | 47 52 | 12 8 | 79903 | 0 | 20097 | 90863 | 0 | 09137 | 10950 | 0 | 89040 | 59 |
| 2 | 47 44 | 12 16 | 79918 | 1 | 20082 | 90889 | 1 | 09111 | 10970 | 0 | 89030 | 58 |
| 3 | 47 36 | 12 24 | 79934 | 1 | 20066 | 90914 | 1 | 09086 | 10980 | 1 | 89020 | 57 |
| 4 | 47 28 | 12 32 | 79950 | 1 | 20050 | 90940 | 2 | 09060 | 10991 | 1 | 89009 | 56 |
| 5 | 6 47 20 | 5 12 40 | 9. 79965 | 1 | 10. 20035 | 9. 90966 | 2 | 10. 09034 | 10. 11001 | 1 | 9. 88999 | 55 |
| 6 | 47 12 | 12 48 | 79981 | 2 | 20019 | 90992 | 3 | 09008 | 11011 | 1 | 88989 | 54 |
| 7 | 47 4 | 12 56 | 79996 | 2 | 20004 | 91018 | 3 | 08982 | 11022 | 1 | 88978 | 53 |
| 8 | 46 56 | 13 4 | 80012 | 2 | 19988 | 91043 | 3 | 08957 | 11032 | 1 | 88968 | 52 |
| 9 | 46 48 | 13 12 | 80027 | 2 | 19973 | 91069 | 4 | 08931 | 11042 | 2 | 88958 | 51 |
| 10 | 6 46 40 | 5 13 20 | 9. 80043 | 3 | 10. 19957 | 9. 91095 | 4 | 10. 08905 | 10. 11052 | 2 | 9. 88943 | 50 |
| 11 | 46 32 | 13 28 | 80058 | 3 | 19942 | 91121 | 5 | 08879 | 11063 | 2 | 88937 | 49 |
| 12 | 46 24 | 13 36 | 80074 | 3 | 19926 | 91147 | 5 | 08853 | 11073 | 2 | 88927 | 48 |
| 13 | 46 16 | 13 44 | 80089 | 3 | 19911 | 91172 | 6 | 08828 | 11083 | 2 | 88917 | 47 |
| 14 | 46 8 | 13 52 | 80105 | 4 | 19895 | 91198 | 6 | 08802 | 11094 | 2 | 88906 | 46 |
| 15 | 6 46 0 | 5 14 0 | 9. 80120 | 4 | 10. 19880 | 9. 91224 | 6 | 10. 08776 | 10. 11104 | 3 | 9. 88896 | 45 |
| 16 | 45 52 | 14 8 | 80136 | 4 | 19864 | 91250 | 7 | 08750 | 11114 | 3 | 88886 | 44 |
| 17 | 45 44 | 14 16 | 80151 | 4 | 19849 | 91276 | 7 | 08724 | 11125 | 3 | 88875 | 43 |
| 18 | 45 36 | 14 24 | 80166 | 5 | 19834 | 91301 | 8 | 08699 | 11135 | 3 | 88865 | 42 |
| 19 | 45 28 | 14 32 | 80182 | 5 | 19818 | 91327 | 8 | 08673 | 11145 | 3 | 88855 | 41 |
| 20 | 6 45 20 | 5 14 40 | 9. 80197 | 5 | 10. 19803 | 9. 91353 | 9 | 10. 08647 | 10. 11156 | 3 | 9. 88844 | 40 |
| 21 | 45 12 | 14 48 | 80213 | 5 | 19787 | 91379 | 9 | 08621 | 11166 | 4 | 88834 | 39 |
| 22 | 45 4 | 14 56 | 80228 | 6 | 19772 | 91404 | 9 | 08596 | 11176 | 4 | 88824 | 38 |
| 23 | 44 56 | 15 4 | 80244 | 6 | 19756 | 91430 | 10 | 08570 | 11187 | 4 | 88813 | 37 |
| 24 | 44 48 | 15 12 | 80259 | 6 | 19741 | 91456 | 10 | 08544 | 11197 | 4 | 88803 | 36 |
| 25 | 6 44 40 | 5 15 20 | 9. 80274 | 6 | 10. 19726 | 9. 91482 | 11 | 10. 08518 | 10. 11207 | 4 | 9. 88793 | 35 |
| 26 | 44 32 | 15 28 | 80290 | 7 | 19710 | 91507 | 11 | 08493 | 11218 | 5 | 88782 | 34 |
| 27 | 44 24 | 15 36 | 80305 | 7 | 19695 | 91533 | 12 | 08467 | 11228 | 5 | 88772 | 33 |
| 28 | 44 16 | 15 44 | 80320 | 7 | 19680 | 91559 | 12 | 08441 | 11239 | 5 | 88761 | 32 |
| 29 | 44 8 | 15 52 | 80336 | 7 | 19664 | 91585 | 12 | 08415 | 11249 | 5 | 88751 | 31 |
| 30 | 6 44 0 | 5 16 0 | 9. 80351 | 8 | 10. 19649 | 9. 91610 | 13 | 10. 08390 | 10. 11259 | 5 | 9. 88741 | 30 |
| 31 | 43 52 | 16 8 | 80366 | 8 | 19634 | 91636 | 13 | 08364 | 11270 | 5 | 88730 | 29 |
| 32 | 43 44 | 16 16 | 80382 | 8 | 19618 | 91662 | 14 | 08338 | 11280 | 6 | 88720 | 28 |
| 33 | 43 36 | 16 24 | 80397 | 8 | 19603 | 91688 | 14 | 08312 | 11291 | 6 | 88709 | 27 |
| 34 | 43 28 | 16 32 | 80412 | 9 | 19588 | 91713 | 15 | 08287 | 11301 | 6 | 88699 | 26 |
| 35 | 6 43 20 | 5 16 40 | 9. 80428 | 9 | 10. 19572 | 9. 91739 | 15 | 10. 08261 | 10. 11312 | 6 | 9. 88688 | 25 |
| 36 | 43 12 | 16 48 | 80443 | 9 | 19557 | 91765 | 15 | 08235 | 11322 | 6 | 88678 | 24 |
| 37 | 43 4 | 16 56 | 80458 | 9 | 19542 | 91791 | 16 | 08209 | 11332 | 6 | 88668 | 23 |
| 38 | 42 56 | 17 4 | 80473 | 10 | 19527 | 91816 | 16 | 08184 | 11343 | 7 | 88657 | 22 |
| 39 | 42 48 | 17 12 | 80489 | 10 | 19511 | 91842 | 17 | 08158 | 11353 | 7 | 88647 | 21 |
| 40 | 6 42 40 | 5 17 20 | 9. 80504 | 10 | 10. 19496 | 9. 91868 | 17 | 10. 08132 | 10. 11364 | 7 | 9. 88636 | 20 |
| 41 | 42 32 | 17 28 | 80519 | 10 | 19481 | 91893 | 18 | 08107 | 11374 | 7 | 88626 | 19 |
| 42 | 42 24 | 17 36 | 80534 | 11 | 19466 | 91919 | 18 | 08081 | 11385 | 7 | 88615 | 18 |
| 43 | 42 16 | 17 44 | 80550 | 11 | 19450 | 91945 | 18 | 08055 | 11395 | 7 | 88605 | 17 |
| 44 | 42 8 | 17 52 | 80565 | 11 | 19435 | 91971 | 19 | 08029 | 11406 | 8 | 88594 | 16 |
| 45 | 6 42 0 | 5 18 0 | 9. 80580 | 12 | 10. 19420 | 9. 91996 | 19 | 10. 08004 | 10. 11416 | 8 | 9. 88584 | 15 |
| 46 | 42 52 | 18 8 | 80595 | 12 | 19405 | 92022 | 20 | 07978 | 11427 | 8 | 88573 | 14 |
| 47 | 41 44 | 18 16 | 80610 | 12 | 19390 | 92048 | 20 | 07952 | 11437 | 8 | 88563 | 13 |
| 48 | 41 36 | 18 24 | 80625 | 12 | 19375 | 92073 | 21 | 07927 | 11448 | 8 | 88552 | 12 |
| 49 | 41 28 | 18 32 | 80641 | 13 | 19359 | 92099 | 21 | 07901 | 11458 | 9 | 88542 | 11 |
| 50 | 6 41 20 | 5 18 40 | 9. 80656 | 13 | 10. 19344 | 9. 92125 | 21 | 10. 07875 | 10. 11469 | 9 | 9. 88531 | 10 |
| 51 | 41 12 | 18 48 | 80671 | 13 | 19329 | 92150 | 22 | 07850 | 11479 | 9 | 88521 | 9 |
| 52 | 41 4 | 18 56 | 80686 | 13 | 19314 | 92176 | 22 | 07824 | 11490 | 9 | 88510 | 8 |
| 53 | 40 56 | 19 4 | 80701 | 14 | 19299 | 92202 | 23 | 07798 | 11501 | 9 | 88499 | 7 |
| 54 | 40 48 | 19 12 | 80716 | 14 | 19284 | 92227 | 23 | 07773 | 11511 | 9 | 88489 | 6 |
| 55 | 6 40 40 | 5 19 20 | 9. 80731 | 14 | 10. 19269 | 9. 92253 | 24 | 10. 07747 | 10. 11522 | 10 | 9. 88478 | 5 |
| 56 | 40 32 | 19 28 | 80746 | 14 | 19254 | 92279 | 24 | 07721 | 11532 | 10 | 88468 | 4 |
| 57 | 40 24 | 19 36 | 80762 | 15 | 19238 | 92304 | 24 | 07696 | 11543 | 10 | 88457 | 3 |
| 58 | 40 16 | 19 44 | 80777 | 15 | 19223 | 92330 | 25 | 07670 | 11553 | 10 | 88447 | 2 |
| 59 | 40 8 | 19 52 | 80792 | 15 | 19208 | 92356 | 25 | 07644 | 11564 | 10 | 88436 | 1 |
| 60 | 40 0 | 20 0 | 80807 | 15 | 19193 | 92381 | 26 | 07619 | 11575 | 10 | 88425 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 6 40 0 | 5 20 0 | 9. 80807 | 0 | 10. 19193 | 9. 92381 | 0 | 10. 07619 | 10. 11575 | 0 | 9. 88425 | 60 |
| 1 | 39 52 | 20 8 | 80822 | 0 | 19178 | 92407 | 0 | 07593 | 11585 | 0 | 88415 | 59 |
| 2 | 39 44 | 20 16 | 80837 | 0 | 19163 | 92433 | 1 | 07567 | 11596 | 0 | 88404 | 58 |
| 3 | 39 36 | 20 24 | 80852 | 1 | 19148 | 92458 | 1 | 07542 | 11606 | 1 | 88394 | 57 |
| 4 | 39 28 | 20 32 | 80867 | 1 | 19133 | 92484 | 2 | 07516 | 11617 | 1 | 88383 | 56 |
| 5 | 6 39 20 | 5 20 40 | 9. 80882 | 1 | 10. 19118 | 9. 92510 | 2 | 10. 07490 | 10. 11628 | 1 | 9. 88372 | 55 |
| 6 | 39 12 | 20 48 | 80897 | 1 | 19103 | 92535 | 3 | 07465 | 11638 | 1 | 88362 | 54 |
| 7 | 39 4 | 20 56 | 80912 | 2 | 19088 | 92561 | 3 | 07439 | 11649 | 1 | 88351 | 53 |
| 8 | 38 56 | 21 4 | 80927 | 2 | 19073 | 92587 | 3 | 07413 | 11660 | 1 | 88340 | 52 |
| 9 | 38 48 | 21 12 | 80942 | 2 | 19058 | 92612 | 4 | 07388 | 11670 | 2 | 88330 | 51 |
| 10 | 6 38 40 | 5 21 20 | 9. 80957 | 2 | 10. 19043 | 9. 92638 | 4 | 10. 07362 | 10. 11681 | 2 | 9. 88319 | 50 |
| 11 | 38 32 | 21 28 | 80972 | 3 | 19028 | 92663 | 5 | 07337 | 11692 | 2 | 88308 | 49 |
| 12 | 38 24 | 21 36 | 80987 | 3 | 19013 | 92689 | 5 | 07311 | 11702 | 2 | 88298 | 48 |
| 13 | 38 16 | 21 44 | 81002 | 3 | 18998 | 92715 | 6 | 07285 | 11713 | 2 | 88287 | 47 |
| 14 | 38 8 | 21 52 | 81017 | 3 | 18983 | 92740 | 6 | 07260 | 11724 | 3 | 88276 | 46 |
| 15 | 6 38 0 | 5 22 0 | 9. 81032 | 4 | 10. 18968 | 9. 92766 | 6 | 10. 07234 | 10. 11734 | 3 | 9. 88266 | 45 |
| 16 | 37 52 | 22 8 | 81047 | 4 | 18953 | 92792 | 7 | 07208 | 11745 | 3 | 88255 | 44 |
| 17 | 37 44 | 22 16 | 81061 | 4 | 18939 | 92817 | 7 | 07183 | 11756 | 3 | 88244 | 43 |
| 18 | 37 36 | 22 24 | 81076 | 4 | 18924 | 92843 | 8 | 07157 | 11766 | 3 | 88234 | 42 |
| 19 | 37 28 | 22 32 | 81091 | 5 | 18909 | 92868 | 8 | 07132 | 11777 | 3 | 88223 | 41 |
| 20 | 6 37 20 | 5 22 40 | 9. 81106 | 5 | 10. 18894 | 9. 92894 | 9 | 10. 07106 | 10. 11788 | 4 | 9. 88212 | 40 |
| 21 | 37 12 | 22 48 | 81121 | 5 | 18879 | 92920 | 9 | 07080 | 11799 | 4 | 88201 | 39 |
| 22 | 37 4 | 22 56 | 81136 | 5 | 18864 | 92945 | 9 | 07055 | 11809 | 4 | 88191 | 38 |
| 23 | 36 56 | 23 4 | 81151 | 6 | 18849 | 92971 | 10 | 07029 | 11820 | 4 | 88180 | 37 |
| 24 | 36 48 | 23 12 | 81166 | 6 | 18834 | 92996 | 10 | 07004 | 11831 | 4 | 88169 | 36 |
| 25 | 6 36 40 | 5 23 20 | 9. 81180 | 6 | 10. 18820 | 9. 93022 | 11 | 10. 06978 | 10. 11842 | 4 | 9. 88158 | 35 |
| 26 | 36 32 | 23 28 | 81195 | 6 | 18805 | 93048 | 11 | 06952 | 11852 | 5 | 88148 | 34 |
| 27 | 36 24 | 23 36 | 81210 | 7 | 18790 | 93073 | 12 | 06927 | 11863 | 5 | 88137 | 33 |
| 28 | 36 16 | 23 44 | 81225 | 7 | 18775 | 93099 | 12 | 06901 | 11874 | 5 | 88126 | 32 |
| 29 | 36 8 | 23 52 | 81240 | 7 | 18760 | 93124 | 12 | 06876 | 11885 | 5 | 88115 | 31 |
| 30 | 6 36 0 | 5 24 0 | 9. 81254 | 7 | 10. 18746 | 9. 93150 | 13 | 10. 06850 | 10. 11895 | 5 | 9. 88105 | 30 |
| 31 | 35 52 | 24 8 | 81269 | 8 | 18731 | 93175 | 13 | 06825 | 11906 | 6 | 88094 | 29 |
| 32 | 35 44 | 24 16 | 81284 | 8 | 18716 | 93201 | 14 | 06799 | 11917 | 6 | 88083 | 28 |
| 33 | 35 36 | 24 24 | 81299 | 8 | 18701 | 93227 | 14 | 06773 | 11928 | 6 | 88072 | 27 |
| 34 | 35 28 | 24 32 | 81314 | 8 | 18686 | 93252 | 14 | 06748 | 11939 | 6 | 88061 | 26 |
| 35 | 6 35 20 | 5 24 40 | 9. 81328 | 9 | 10. 18672 | 9. 93278 | 15 | 10. 06722 | 10. 11949 | 6 | 9. 88051 | 25 |
| 36 | 35 12 | 24 48 | 81343 | 9 | 18657 | 93303 | 15 | 06697 | 11960 | 6 | 88040 | 24 |
| 37 | 35 4 | 24 56 | 81358 | 9 | 18642 | 93329 | 16 | 06671 | 11971 | 7 | 88029 | 23 |
| 38 | 34 56 | 25 4 | 81372 | 9 | 18628 | 93354 | 16 | 06646 | 11982 | 7 | 88018 | 22 |
| 39 | 34 48 | 25 12 | 81387 | 10 | 18613 | 93380 | 17 | 06620 | 11993 | 7 | 88007 | 21 |
| 40 | 6 34 40 | 5 25 20 | 9. 81402 | 10 | 10. 18598 | 9. 93406 | 17 | 10. 06594 | 10. 12004 | 7 | 9. 87996 | 20 |
| 41 | 34 32 | 25 28 | 81417 | 10 | 18583 | 93431 | 17 | 06569 | 12015 | 7 | 87985 | 19 |
| 42 | 34 24 | 25 36 | 81431 | 10 | 18569 | 93457 | 18 | 06543 | 12025 | 8 | 87975 | 18 |
| 43 | 34 16 | 25 44 | 81446 | 11 | 18554 | 93482 | 18 | 06518 | 12036 | 8 | 87964 | 17 |
| 44 | 34 8 | 25 52 | 81461 | 11 | 18539 | 93508 | 19 | 06492 | 12047 | 8 | 87953 | 16 |
| 45 | 6 34 0 | 5 26 0 | 9. 81475 | 11 | 10. 18525 | 9. 93533 | 19 | 10. 06467 | 10. 12058 | 8 | 9. 87942 | 15 |
| 46 | 33 52 | 26 8 | 81490 | 11 | 18510 | 93559 | 20 | 06441 | 12069 | 8 | 87931 | 14 |
| 47 | 33 44 | 26 16 | 81505 | 12 | 18495 | 93584 | 20 | 06416 | 12080 | 8 | 87920 | 13 |
| 48 | 33 36 | 26 24 | 81519 | 12 | 18481 | 93610 | 20 | 06390 | 12091 | 9 | 87909 | 12 |
| 49 | 33 28 | 26 32 | 81534 | 12 | 18466 | 93636 | 21 | 06364 | 12102 | 9 | 87898 | 11 |
| 50 | 6 33 20 | 5 26 40 | 9. 81549 | 12 | 10. 18451 | 9. 93661 | 21 | 10. 06339 | 10. 12113 | 9 | 9. 87887 | 10 |
| 51 | 33 12 | 26 48 | 81563 | 13 | 18437 | 93687 | 22 | 06313 | 12123 | 9 | 87877 | 9 |
| 52 | 33 4 | 26 56 | 81578 | 13 | 18422 | 93712 | 22 | 06288 | 12134 | 9 | 87866 | 8 |
| 53 | 32 56 | 27 4 | 81592 | 13 | 18408 | 93738 | 23 | 06262 | 12145 | 10 | 87855 | 7 |
| 54 | 32 48 | 27 12 | 81607 | 13 | 18393 | 93763 | 23 | 06237 | 12156 | 10 | 87844 | 6 |
| 55 | 6 32 40 | 5 27 20 | 9. 81622 | 14 | 10. 18378 | 9. 93789 | 23 | 10. 06211 | 10. 12167 | 10 | 9. 87833 | 5 |
| 56 | 32 32 | 27 28 | 81636 | 14 | 18364 | 93814 | 24 | 06186 | 12178 | 10 | 87822 | 4 |
| 57 | 32 24 | 27 36 | 81651 | 14 | 18349 | 93840 | 24 | 06160 | 12189 | 10 | 87811 | 3 |
| 58 | 32 16 | 27 44 | 81665 | 14 | 18335 | 93865 | 25 | 06135 | 12200 | 10 | 87800 | 2 |
| 59 | 32 8 | 27 52 | 81680 | 15 | 18320 | 93891 | 25 | 06109 | 12211 | 11 | 87789 | 1 |
| 60 | 32 0 | 28 0 | 81694 | 15 | 18306 | 93916 | 26 | 06084 | 12222 | 11 | 87778 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 6 32 0 | 5 28 0 | 9. 81694 | 0 | 10. 18306 | 9. 93916 | 0 | 10. 06084 | 10. 12222 | 0 | 9. 87778 | 60 |
| 1 | 31 52 | 28 8 | 81709 | 0 | 18291 | 93942 | 0 | 06085 | 12233 | 0 | 87767 | 59 |
| 2 | 31 44 | 28 16 | 81723 | 0 | 18277 | 93967 | 1 | 06033 | 12244 | 0 | 87756 | 58 |
| 3 | 31 36 | 28 24 | 81738 | 1 | 18262 | 93993 | 1 | 06007 | 12255 | 1 | 87745 | 57 |
| 4 | 31 28 | 28 32 | 81752 | 1 | 18248 | 94018 | 2 | 05982 | 12266 | 1 | 87734 | 56 |
| 5 | 6 31 20 | 5 28 40 | 9. 81767 | 1 | 10. 18233 | 9. 94044 | 2 | 10. 05956 | 10. 12277 | 1 | 9. 87723 | 55 |
| 6 | 31 12 | 28 48 | 81781 | 1 | 18219 | 94069 | 3 | 05931 | 12288 | 1 | 87712 | 54 |
| 7 | 31 4 | 28 56 | 81796 | 2 | 18204 | 94095 | 3 | 05905 | 12299 | 1 | 87701 | 53 |
| 8 | 30 56 | 29 4 | 81810 | 2 | 18190 | 94120 | 3 | 05880 | 12310 | 1 | 87690 | 52 |
| 9 | 30 48 | 29 12 | 81825 | 2 | 18175 | 94146 | 4 | 05854 | 12321 | 2 | 87679 | 51 |
| 10 | 6 30 40 | 5 29 20 | 9. 81839 | 2 | 10. 18161 | 9. 94171 | 4 | 10. 05829 | 10. 12332 | 2 | 9. 87668 | 50 |
| 11 | 30 32 | 29 28 | 81854 | 3 | 18146 | 94197 | 5 | 05803 | 12343 | 2 | 87657 | 49 |
| 12 | 30 24 | 29 36 | 81868 | 3 | 18132 | 94222 | 5 | 05778 | 12354 | 2 | 87646 | 48 |
| 13 | 30 16 | 29 44 | 81882 | 3 | 18118 | 94248 | 6 | 05752 | 12365 | 2 | 87635 | 47 |
| 14 | 30 8 | 29 52 | 81897 | 3 | 18103 | 94273 | 6 | 05727 | 12376 | 3 | 87624 | 46 |
| 15 | 6 30 0 | 5 30 0 | 9. 81911 | 4 | 10. 18089 | 9. 94299 | 6 | 10. 05701 | 10. 12387 | 3 | 9. 87613 | 45 |
| 16 | 29 52 | 30 8 | 81926 | 4 | 18074 | 94324 | 7 | 05676 | 12399 | 3 | 87601 | 44 |
| 17 | 29 44 | 30 16 | 81940 | 4 | 18060 | 94350 | 7 | 05650 | 12410 | 3 | 87590 | 43 |
| 18 | 29 36 | 30 24 | 81955 | 4 | 18045 | 94375 | 8 | 05625 | 12421 | 3 | 87579 | 42 |
| 19 | 29 28 | 30 32 | 81969 | 5 | 18031 | 94401 | 8 | 05599 | 12432 | 4 | 87568 | 41 |
| 20 | 6 29 20 | 5 30 40 | 9. 81983 | 5 | 10. 18017 | 9. 94426 | 8 | 10. 05574 | 10. 12443 | 4 | 9. 87557 | 40 |
| 21 | 29 12 | 30 48 | 81998 | 5 | 18002 | 94452 | 9 | 05548 | 12454 | 4 | 87546 | 39 |
| 22 | 29 4 | 30 56 | 82012 | 5 | 17988 | 94477 | 9 | 05523 | 12465 | 4 | 87535 | 38 |
| 23 | 28 56 | 31 4 | 82026 | 5 | 17974 | 94503 | 10 | 05497 | 12476 | 4 | 87524 | 37 |
| 24 | 28 48 | 31 12 | 82041 | 6 | 17959 | 94528 | 10 | 05472 | 12487 | 4 | 87513 | 36 |
| 25 | 6 28 40 | 5 31 20 | 9. 82055 | 6 | 10. 17945 | 9. 94554 | 11 | 10. 05446 | 10. 12499 | 5 | 9. 87501 | 35 |
| 26 | 28 32 | 31 28 | 82069 | 6 | 17931 | 94579 | 11 | 05421 | 12510 | 5 | 87490 | 34 |
| 27 | 28 24 | 31 36 | 82084 | 6 | 17916 | 94604 | 11 | 05396 | 12521 | 5 | 87479 | 33 |
| 28 | 28 16 | 31 44 | 82098 | 7 | 17902 | 94630 | 12 | 05370 | 12532 | 5 | 87468 | 32 |
| 29 | 28 8 | 31 52 | 82112 | 7 | 17888 | 94655 | 12 | 05345 | 12543 | 5 | 87457 | 31 |
| 30 | 6 28 0 | 5 32 0 | 9. 82126 | 7 | 10. 17874 | 9. 94681 | 13 | 10. 05319 | 10. 12554 | 6 | 9. 87446 | 30 |
| 31 | 27 52 | 32 8 | 82141 | 7 | 17859 | 94706 | 13 | 05294 | 12566 | 6 | 87434 | 29 |
| 32 | 27 44 | 32 16 | 82155 | 8 | 17845 | 94732 | 14 | 05268 | 12577 | 6 | 87423 | 28 |
| 33 | 27 36 | 32 24 | 82169 | 8 | 17831 | 94757 | 14 | 05243 | 12588 | 6 | 87412 | 27 |
| 34 | 27 28 | 32 32 | 82184 | 8 | 17816 | 94783 | 14 | 05217 | 12599 | 6 | 87401 | 26 |
| 35 | 6 27 20 | 5 32 40 | 9. 82198 | 8 | 10. 17802 | 9. 94808 | 15 | 10. 05192 | 10. 12610 | 7 | 9. 87390 | 25 |
| 36 | 27 12 | 32 48 | 82212 | 9 | 17788 | 94834 | 15 | 05166 | 12622 | 7 | 87378 | 24 |
| 37 | 27 4 | 32 56 | 82226 | 9 | 17774 | 94859 | 16 | 05141 | 12633 | 7 | 87367 | 23 |
| 38 | 26 56 | 33 4 | 82240 | 9 | 17760 | 94884 | 16 | 05116 | 12644 | 7 | 87356 | 22 |
| 39 | 26 48 | 33 12 | 82255 | 9 | 17745 | 94910 | 17 | 05090 | 12655 | 7 | 87345 | 21 |
| 40 | 6 26 40 | 5 33 20 | 9. 82269 | 10 | 10. 17731 | 9. 94935 | 17 | 10. 05065 | 10. 12666 | 7 | 9. 87334 | 20 |
| 41 | 26 32 | 33 28 | 82283 | 10 | 17717 | 94961 | 17 | 05039 | 12678 | 8 | 87322 | 19 |
| 42 | 26 24 | 33 36 | 82297 | 10 | 17703 | 94986 | 18 | 05014 | 12689 | 8 | 87311 | 18 |
| 43 | 26 16 | 33 44 | 82311 | 10 | 17689 | 95012 | 18 | 04988 | 12700 | 8 | 87300 | 17 |
| 44 | 26 8 | 33 52 | 82326 | 10 | 17674 | 95037 | 19 | 04963 | 12712 | 8 | 87288 | 16 |
| 45 | 6 26 0 | 5 34 0 | 9. 82340 | 11 | 10. 17660 | 9. 95062 | 19 | 10. 04938 | 10. 12723 | 8 | 9. 87277 | 15 |
| 46 | 25 52 | 34 8 | 82354 | 11 | 17646 | 95088 | 20 | 04912 | 12734 | 9 | 87266 | 14 |
| 47 | 25 44 | 34 16 | 82368 | 11 | 17632 | 95113 | 20 | 04887 | 12745 | 9 | 87255 | 13 |
| 48 | 25 36 | 34 24 | 82382 | 11 | 17618 | 95139 | 20 | 04861 | 12757 | 9 | 87243 | 12 |
| 49 | 25 28 | 34 32 | 82396 | 12 | 17604 | 95164 | 21 | 04836 | 12768 | 9 | 87232 | 11 |
| 50 | 6 25 20 | 5 34 40 | 9. 82410 | 12 | 10. 17590 | 9. 95190 | 21 | 10. 04810 | 10. 12779 | 9 | 9. 87221 | 10 |
| 51 | 25 12 | 34 48 | 82424 | 12 | 17576 | 95215 | 22 | 04785 | 12791 | 10 | 87209 | 9 |
| 52 | 25 4 | 34 56 | 82439 | 12 | 17561 | 95240 | 22 | 04760 | 12802 | 10 | 87198 | 8 |
| 53 | 24 56 | 35 4 | 82453 | 13 | 17547 | 95266 | 22 | 04734 | 12813 | 10 | 87187 | 7 |
| 54 | 24 48 | 35 12 | 82467 | 13 | 17533 | 95291 | 23 | 04709 | 12825 | 10 | 87175 | 6 |
| 55 | 6 24 40 | 5 35 20 | 9. 82481 | 13 | 10. 17519 | 9. 95317 | 23 | 10. 04683 | 10. 12836 | 10 | 9. 87164 | 5 |
| 56 | 24 32 | 35 28 | 82495 | 13 | 17505 | 95342 | 24 | 04658 | 12847 | 10 | 87153 | 4 |
| 57 | 24 24 | 35 36 | 82509 | 14 | 17491 | 95368 | 24 | 04632 | 12859 | 11 | 87141 | 3 |
| 58 | 24 16 | 35 44 | 82523 | 14 | 17477 | 95393 | 25 | 04607 | 12870 | 11 | 87130 | 2 |
| 59 | 24 8 | 35 52 | 82537 | 14 | 17463 | 95418 | 25 | 04582 | 12881 | 11 | 87119 | 1 |
| 60 | 24 0 | 36 0 | 82551 | 14 | 17449 | 95444 | 25 | 04556 | 12893 | 11 | 87107 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| N. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|
| 0 | 6 24 0 | 5 36 0 | 9. 82551 | 0 | 10. 17449 | 9. 95444 | 0 | 10. 04556 | 10. 12893 | 0 | 9. 87107 |
| 1 | 23 52 | 36 8 | 82565 | 0 | 17435 | 95469 | 0 | 04531 | 12904 | 0 | 87096 |
| 2 | 23 44 | 36 16 | 82579 | 0 | 17421 | 95495 | 1 | 04505 | 12915 | 0 | 87085 |
| 3 | 23 36 | 36 24 | 82593 | 1 | 17407 | 95520 | 1 | 04480 | 12927 | 1 | 87073 |
| 4 | 23 28 | 36 32 | 82607 | 1 | 17393 | 95545 | 2 | 04455 | 12938 | 1 | 87062 |
| 5 | 6 23 20 | 5 36 40 | 9. 82621 | 1 | 10. 17379 | 9. 95571 | 2 | 10. 04429 | 10. 12950 | 1 | 9. 87050 |
| 6 | 23 12 | 36 48 | 82635 | 1 | 17365 | 95596 | 3 | 04404 | 12961 | 1 | 87039 |
| 7 | 23 4 | 36 56 | 82649 | 2 | 17351 | 95622 | 3 | 04378 | 12972 | 1 | 87028 |
| 8 | 22 56 | 37 4 | 82663 | 2 | 17337 | 95647 | 3 | 04353 | 12984 | 2 | 87016 |
| 9 | 22 48 | 37 12 | 82677 | 2 | 17323 | 95672 | 4 | 04328 | 12995 | 2 | 87005 |
| 10 | 6 22 40 | 5 37 20 | 9. 82691 | 2 | 10. 17309 | 9. 95698 | 4 | 10. 04302 | 10. 13007 | 2 | 9. 86993 |
| 11 | 22 32 | 37 28 | 82705 | 3 | 17295 | 95723 | 5 | 04277 | 13018 | 2 | 86982 |
| 12 | 22 24 | 37 36 | 82719 | 3 | 17281 | 95748 | 5 | 04252 | 13030 | 2 | 86970 |
| 13 | 22 16 | 37 44 | 82733 | 3 | 17267 | 95774 | 5 | 04226 | 13041 | 3 | 86959 |
| 14 | 22 8 | 37 52 | 82747 | 3 | 17253 | 95799 | 6 | 04201 | 13053 | 3 | 86947 |
| 15 | 6 22 0 | 5 38 0 | 9. 82761 | 3 | 10. 17239 | 9. 95825 | 6 | 10. 04175 | 10. 13064 | 3 | 9. 86936 |
| 16 | 21 52 | 38 8 | 82775 | 4 | 17225 | 95850 | 7 | 04150 | 13076 | 3 | 86924 |
| 17 | 21 44 | 38 16 | 82788 | 4 | 17212 | 95875 | 7 | 04125 | 13087 | 3 | 86913 |
| 18 | 21 36 | 38 24 | 82802 | 4 | 17198 | 95900 | 8 | 04099 | 13098 | 3 | 86902 |
| 19 | 21 28 | 38 32 | 82816 | 4 | 17184 | 95926 | 8 | 04074 | 13110 | 4 | 86890 |
| 20 | 6 21 20 | 5 38 40 | 9. 82830 | 5 | 10. 17170 | 9. 95952 | 8 | 10. 04048 | 10. 13121 | 4 | 9. 86879 |
| 21 | 21 12 | 38 48 | 82844 | 5 | 17156 | 95977 | 9 | 04023 | 13133 | 4 | 86867 |
| 22 | 21 4 | 38 56 | 82858 | 5 | 17142 | 96002 | 9 | 03998 | 13145 | 4 | 86855 |
| 23 | 20 56 | 39 4 | 82872 | 5 | 17128 | 96028 | 10 | 03972 | 13156 | 4 | 86844 |
| 24 | 20 48 | 39 12 | 82885 | 6 | 17115 | 96053 | 10 | 03947 | 13168 | 5 | 86832 |
| 25 | 6 20 40 | 5 39 20 | 9. 82899 | 6 | 10. 17101 | 9. 96078 | 11 | 10. 03922 | 10. 13179 | 5 | 9. 86821 |
| 26 | 20 32 | 39 28 | 82913 | 6 | 17087 | 96104 | 11 | 03896 | 13191 | 5 | 86809 |
| 27 | 20 24 | 39 36 | 82927 | 6 | 17073 | 96129 | 11 | 03871 | 13202 | 5 | 86798 |
| 28 | 20 16 | 39 44 | 82941 | 6 | 17059 | 96155 | 12 | 03845 | 13214 | 5 | 86786 |
| 29 | 20 8 | 39 52 | 82955 | 7 | 17045 | 96180 | 12 | 03820 | 13225 | 6 | 86775 |
| 30 | 6 20 0 | 5 40 0 | 9. 82968 | 7 | 10. 17032 | 9. 96205 | 13 | 10. 03795 | 10. 13237 | 6 | 9. 86763 |
| 31 | 19 52 | 40 8 | 82982 | 7 | 17018 | 96231 | 13 | 03769 | 13248 | 6 | 86752 |
| 32 | 19 44 | 40 16 | 82996 | 7 | 17004 | 96256 | 14 | 03744 | 13260 | 6 | 86740 |
| 33 | 19 36 | 40 24 | 83010 | 8 | 16990 | 96281 | 14 | 03719 | 13272 | 6 | 86728 |
| 34 | 19 28 | 40 32 | 83023 | 8 | 16977 | 96307 | 14 | 03693 | 13283 | 7 | 86717 |
| 35 | 6 19 20 | 5 40 40 | 9. 83037 | 8 | 10. 16963 | 9. 96332 | 15 | 10. 03668 | 10. 13295 | 7 | 9. 86705 |
| 36 | 19 12 | 40 48 | 83051 | 8 | 16949 | 96357 | 15 | 03643 | 13306 | 7 | 86694 |
| 37 | 19 4 | 40 56 | 83065 | 8 | 16935 | 96383 | 16 | 03617 | 13318 | 7 | 86682 |
| 38 | 18 56 | 41 4 | 83078 | 9 | 16922 | 96408 | 16 | 03592 | 13330 | 7 | 86670 |
| 39 | 18 48 | 41 12 | 83092 | 9 | 16908 | 96433 | 16 | 03567 | 13341 | 8 | 86659 |
| 40 | 6 18 40 | 5 41 20 | 9. 83106 | 9 | 10. 16894 | 9. 96459 | 17 | 10. 03541 | 10. 13353 | 8 | 9. 86647 |
| 41 | 18 32 | 41 28 | 83120 | 9 | 16880 | 96484 | 17 | 03516 | 13365 | 8 | 86635 |
| 42 | 18 24 | 41 36 | 83133 | 10 | 16867 | 96510 | 18 | 03490 | 13376 | 8 | 86624 |
| 43 | 18 16 | 41 44 | 83147 | 10 | 16853 | 96535 | 18 | 03465 | 13388 | 8 | 86612 |
| 44 | 18 8 | 41 52 | 83161 | 10 | 16839 | 96560 | 19 | 03440 | 13400 | 8 | 86600 |
| 45 | 6 18 0 | 5 42 0 | 9. 83174 | 10 | 10. 16826 | 9. 96586 | 19 | 10. 03414 | 10. 13411 | 9 | 9. 86589 |
| 46 | 17 52 | 42 8 | 83188 | 11 | 16812 | 96611 | 19 | 03389 | 13423 | 9 | 86577 |
| 47 | 17 44 | 42 16 | 83202 | 11 | 16798 | 96636 | 20 | 03364 | 13435 | 9 | 86565 |
| 48 | 17 36 | 42 24 | 83215 | 11 | 16785 | 96662 | 20 | 03338 | 13446 | 9 | 86554 |
| 49 | 17 28 | 42 32 | 83229 | 11 | 16771 | 96687 | 21 | 03313 | 13458 | 9 | 86542 |
| 50 | 6 17 20 | 5 42 40 | 9. 83242 | 11 | 10. 16758 | 9. 96712 | 21 | 10. 03288 | 10. 13470 | 10 | 9. 86530 |
| 51 | 17 12 | 42 48 | 83256 | 12 | 16744 | 96738 | 22 | 03262 | 13482 | 10 | 86518 |
| 52 | 17 4 | 42 56 | 83270 | 12 | 16730 | 96763 | 22 | 03237 | 13493 | 10 | 86507 |
| 53 | 16 56 | 43 4 | 83283 | 12 | 16717 | 96788 | 22 | 03212 | 13505 | 10 | 86495 |
| 54 | 16 48 | 43 12 | 83297 | 12 | 16703 | 96814 | 23 | 03186 | 13517 | 10 | 86483 |
| 55 | 6 16 40 | 5 43 20 | 9. 83310 | 13 | 10. 16690 | 9. 96839 | 23 | 10. 03161 | 10. 13528 | 11 | 9. 86472 |
| 56 | 16 32 | 43 28 | 83324 | 13 | 16676 | 96864 | 24 | 03136 | 13540 | 11 | 86460 |
| 57 | 16 24 | 43 36 | 83338 | 13 | 16662 | 96890 | 24 | 03110 | 13552 | 11 | 86448 |
| 58 | 16 16 | 43 44 | 83351 | 13 | 16649 | 96915 | 25 | 03085 | 13564 | 11 | 86436 |
| 59 | 16 8 | 43 52 | 83365 | 14 | 16635 | 96940 | 25 | 03060 | 13575 | 11 | 86425 |
| 60 | 16 0 | 44 0 | 83378 | 14 | 16622 | 96966 | 25 | 03034 | 13587 | 12 | 86413 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. |

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|----------|-------|-----------|------------|-------|------------|-----------|-------|----------|----|
| 0 | 6 16 0 | 5 44 0 | 9. 83378 | 0 | 10. 16622 | 9. 96966 | 0 | 10. 03034 | 10. 13587 | 0 | 9. 86413 | 60 |
| 1 | 15 52 | 44 8 | 83392 | 0 | 16608 | 96991 | 0 | 03009 | 13599 | 0 | 86401 | 59 |
| 2 | 15 44 | 44 16 | 83405 | 0 | 16595 | 97016 | 1 | 02984 | 13611 | 0 | 86389 | 58 |
| 3 | 15 36 | 44 24 | 83419 | 1 | 16581 | 97042 | 1 | 02958 | 13623 | 1 | 86377 | 57 |
| 4 | 15 28 | 44 32 | 83432 | 1 | 16568 | 97067 | 2 | 02933 | 13634 | 1 | 86366 | 56 |
| 5 | 6 15 20 | 5 44 40 | 9. 83446 | 1 | 10. 16554 | 9. 97092 | 2 | 10. 02908 | 10. 13646 | 1 | 9. 86354 | 55 |
| 6 | 15 12 | 44 48 | 83459 | 1 | 16541 | 97118 | 3 | 02882 | 13658 | 1 | 86342 | 54 |
| 7 | 15 4 | 44 56 | 83473 | 2 | 16527 | 97143 | 3 | 02857 | 13670 | 1 | 86330 | 53 |
| 8 | 14 56 | 45 4 | 83486 | 2 | 16514 | 97168 | 3 | 02832 | 13682 | 2 | 86318 | 52 |
| 9 | 14 48 | 45 12 | 83500 | 2 | 16500 | 97193 | 4 | 02807 | 13694 | 2 | 86306 | 51 |
| 10 | 6 14 40 | 5 45 20 | 9. 83513 | 2 | 10. 16487 | 9. 97219 | 4 | 10. 02781 | 10. 13705 | 2 | 9. 86295 | 50 |
| 11 | 14 32 | 45 28 | 83527 | 2 | 16473 | 97244 | 5 | 02756 | 13717 | 2 | 86283 | 49 |
| 12 | 14 24 | 45 36 | 83540 | 3 | 16460 | 97269 | 5 | 02731 | 13729 | 2 | 86271 | 48 |
| 13 | 14 16 | 45 44 | 83554 | 3 | 16446 | 97295 | 5 | 02705 | 13741 | 3 | 86259 | 47 |
| 14 | 14 8 | 45 52 | 83567 | 3 | 16433 | 97320 | 6 | 02680 | 13753 | 3 | 86247 | 46 |
| 15 | 6 14 0 | 5 46 0 | 9. 83581 | 3 | 10. 16419 | 9. 97345 | 6 | 10. 02655 | 10. 13765 | 3 | 9. 86235 | 45 |
| 16 | 13 52 | 46 8 | 83594 | 4 | 16406 | 97371 | 7 | 02629 | 13777 | 3 | 86223 | 44 |
| 17 | 13 44 | 46 16 | 83608 | 4 | 16392 | 97396 | 7 | 02604 | 13789 | 3 | 86211 | 43 |
| 18 | 13 36 | 46 24 | 83621 | 4 | 16379 | 97421 | 8 | 02579 | 13800 | 4 | 86200 | 42 |
| 19 | 13 28 | 46 32 | 83634 | 4 | 16366 | 97447 | 8 | 02553 | 13812 | 4 | 86188 | 41 |
| 20 | 6 13 20 | 5 46 40 | 9. 83648 | 4 | 10. 16352 | 9. 97472 | 8 | 10. 02528 | 10. 13824 | 4 | 9. 86176 | 40 |
| 21 | 13 12 | 46 48 | 83661 | 5 | 16339 | 97497 | 9 | 02503 | 13836 | 4 | 86164 | 39 |
| 22 | 13 4 | 46 56 | 83674 | 5 | 16326 | 97523 | 9 | 02477 | 13848 | 4 | 86152 | 38 |
| 23 | 12 56 | 47 4 | 83688 | 5 | 16312 | 97548 | 10 | 02452 | 13860 | 5 | 86140 | 37 |
| 24 | 12 48 | 47 12 | 83701 | 5 | 16299 | 97573 | 10 | 02427 | 13872 | 5 | 86128 | 36 |
| 25 | 6 12 40 | 5 47 20 | 9. 83715 | 6 | 10. 16285 | 9. 97598 | 11 | 10. 02402 | 10. 13884 | 5 | 9. 86116 | 35 |
| 26 | 12 32 | 47 28 | 83728 | 6 | 16272 | 97624 | 11 | 02376 | 13896 | 5 | 86104 | 34 |
| 27 | 12 24 | 47 36 | 83741 | 6 | 16259 | 97649 | 11 | 02351 | 13908 | 5 | 86092 | 33 |
| 28 | 12 16 | 47 44 | 83755 | 6 | 16245 | 97674 | 12 | 02326 | 13920 | 6 | 86080 | 32 |
| 29 | 12 8 | 47 52 | 83768 | 6 | 16232 | 97700 | 12 | 02300 | 13932 | 6 | 86068 | 31 |
| 30 | 6 12 0 | 5 48 0 | 9. 83781 | 7 | 10. 16219 | 9. 97725 | 13 | 10. 02275 | 10. 13944 | 6 | 9. 86056 | 30 |
| 31 | 11 52 | 48 8 | 83795 | 7 | 16205 | 97750 | 13 | 02250 | 13956 | 6 | 86044 | 29 |
| 32 | 11 44 | 48 16 | 83808 | 7 | 16192 | 97776 | 13 | 02224 | 13968 | 6 | 86032 | 28 |
| 33 | 11 36 | 48 24 | 83821 | 7 | 16179 | 97801 | 14 | 02199 | 13980 | 7 | 86020 | 27 |
| 34 | 11 28 | 48 32 | 83834 | 8 | 16166 | 97826 | 14 | 02174 | 13992 | 7 | 86008 | 26 |
| 35 | 6 11 20 | 5 48 40 | 9. 83848 | 8 | 10. 16152 | 9. 97851 | 15 | 10. 02149 | 10. 14004 | 7 | 9. 85996 | 25 |
| 36 | 11 12 | 48 48 | 83861 | 8 | 16139 | 97877 | 15 | 02123 | 14016 | 7 | 85984 | 24 |
| 37 | 11 4 | 48 56 | 83874 | 8 | 16126 | 97902 | 16 | 02098 | 14028 | 7 | 85972 | 23 |
| 38 | 10 56 | 49 4 | 83887 | 8 | 16113 | 97927 | 16 | 02073 | 14040 | 8 | 85960 | 22 |
| 39 | 10 48 | 49 12 | 83901 | 9 | 16099 | 97953 | 16 | 02047 | 14052 | 8 | 85948 | 21 |
| 40 | 6 10 40 | 5 49 20 | 9. 83914 | 9 | 10. 16086 | 9. 97978 | 17 | 10. 02022 | 10. 14064 | 8 | 9. 85936 | 20 |
| 41 | 10 32 | 49 28 | 83927 | 9 | 16073 | 98003 | 17 | 01997 | 14076 | 8 | 85924 | 19 |
| 42 | 10 24 | 49 36 | 83940 | 9 | 16060 | 98029 | 18 | 01971 | 14088 | 8 | 85912 | 18 |
| 43 | 10 16 | 49 44 | 83954 | 10 | 16046 | 98054 | 18 | 01946 | 14100 | 9 | 85900 | 17 |
| 44 | 10 8 | 49 52 | 83967 | 10 | 16033 | 98079 | 19 | 01921 | 14112 | 9 | 85888 | 16 |
| 45 | 6 10 0 | 5 50 0 | 9. 83980 | 10 | 10. 16020 | 9. 98104 | 19 | 10. 01896 | 10. 14124 | 9 | 9. 85876 | 15 |
| 46 | 9 52 | 50 8 | 83993 | 10 | 16007 | 98130 | 19 | 01870 | 14136 | 9 | 85864 | 14 |
| 47 | 9 44 | 50 16 | 84006 | 10 | 15994 | 98155 | 20 | 01845 | 14149 | 9 | 85851 | 13 |
| 48 | 9 36 | 50 24 | 84020 | 11 | 15980 | 98180 | 20 | 01820 | 14161 | 10 | 85839 | 12 |
| 49 | 9 28 | 50 32 | 84033 | 11 | 15967 | 98206 | 21 | 01794 | 14173 | 10 | 85827 | 11 |
| 50 | 6 9 20 | 5 50 40 | 9. 84046 | 11 | 10. 15954 | 9. 98231 | 21 | 10. 01769 | 10. 14185 | 10 | 9. 85815 | 10 |
| 51 | 9 12 | 50 48 | 84059 | 11 | 15941 | 98256 | 22 | 01744 | 14197 | 10 | 85803 | 9 |
| 52 | 9 4 | 50 56 | 84072 | 12 | 15928 | 98281 | 22 | 01719 | 14209 | 10 | 85791 | 8 |
| 53 | 8 56 | 51 4 | 84085 | 12 | 15915 | 98307 | 22 | 01693 | 14221 | 11 | 85779 | 7 |
| 54 | 8 48 | 51 12 | 84098 | 12 | 15902 | 98332 | 23 | 01668 | 14234 | 11 | 85766 | 6 |
| 55 | 6 8 40 | 5 51 20 | 9. 84112 | 12 | 10. 15888 | 9. 98357 | 23 | 10. 01643 | 10. 14246 | 11 | 9. 85754 | 5 |
| 56 | 8 32 | 51 28 | 84125 | 12 | 15875 | 98383 | 24 | 01617 | 14258 | 11 | 85742 | 4 |
| 57 | 8 24 | 51 36 | 84138 | 13 | 15862 | 98408 | 24 | 01592 | 14270 | 11 | 85730 | 3 |
| 58 | 8 16 | 51 44 | 84151 | 13 | 15849 | 98433 | 24 | 01567 | 14282 | 12 | 85718 | 2 |
| 59 | 8 8 | 51 52 | 84164 | 13 | 15836 | 98458 | 25 | 01542 | 14294 | 12 | 85706 | 1 |
| 60 | 8 0 | 52 0 | 84177 | 13 | 15823 | 98484 | 25 | 01516 | 14307 | 12 | 85693 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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SINES, TANGENTS, AND SECANTS.

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| M. | Hour A. M. | Hour P. M. | Sine. | Diff. | Cosecant. | Tangent. | Diff. | Cotangent. | Secant. | Diff. | Cosine. | M. |
|----|------------|------------|---------|-------|-----------|------------|-------|------------|-----------|-------|---------|----|
| 0 | 6 8 0 | 5 52 0 | 9.84177 | 0 | 10.15823 | 9.98484 | 0 | 10.01516 | 10.14307 | 0 | 9.85693 | 60 |
| 1 | 7 52 | 52 8 | 84190 | 0 | 15810 | 98509 | 0 | 01491 | 14319 | 0 | 85681 | 59 |
| 2 | 7 44 | 52 16 | 84203 | 0 | 15797 | 98534 | 1 | 01466 | 14331 | 0 | 85669 | 58 |
| 3 | 7 36 | 52 24 | 84216 | 1 | 15784 | 98560 | 1 | 01440 | 14343 | 1 | 85657 | 57 |
| 4 | 7 28 | 52 32 | 84229 | 1 | 15771 | 98585 | 2 | 01415 | 14355 | 1 | 85645 | 56 |
| 5 | 6 20 | 5 52 40 | 9.84242 | 1 | 10.15758 | 9.98610 | 2 | 10.01390 | 10.14368 | 1 | 9.85632 | 55 |
| 6 | 7 12 | 52 48 | 84255 | 1 | 15745 | 98635 | 3 | 01365 | 14380 | 1 | 85620 | 54 |
| 7 | 7 4 | 52 56 | 84269 | 2 | 15731 | 98661 | 3 | 01339 | 14392 | 1 | 85608 | 53 |
| 8 | 6 56 | 53 4 | 84282 | 2 | 15718 | 98686 | 3 | 01314 | 14404 | 2 | 85596 | 52 |
| 9 | 6 48 | 53 12 | 84295 | 2 | 15705 | 98711 | 4 | 01289 | 14417 | 2 | 85583 | 51 |
| 10 | 6 40 | 5 53 20 | 9.84308 | 2 | 10.15692 | 9.98737 | 4 | 10.01263 | 10.14429 | 2 | 9.85571 | 50 |
| 11 | 6 32 | 53 28 | 84321 | 2 | 15679 | 98762 | 5 | 01238 | 14441 | 2 | 85559 | 49 |
| 12 | 6 24 | 53 36 | 84334 | 3 | 15666 | 98787 | 5 | 01213 | 14453 | 2 | 85547 | 48 |
| 13 | 6 16 | 53 44 | 84347 | 3 | 15653 | 98812 | 5 | 01188 | 14466 | 3 | 85534 | 47 |
| 14 | 6 8 | 53 52 | 84360 | 3 | 15640 | 98838 | 6 | 01163 | 14478 | 3 | 85522 | 46 |
| 15 | 0 6 0 | 5 54 0 | 9.84373 | 3 | 10.15627 | 9.98863 | 6 | 10.01137 | 10.14490 | 3 | 9.85510 | 45 |
| 16 | 5 52 | 54 8 | 84385 | 3 | 15615 | 98888 | 7 | 01112 | 14503 | 3 | 85497 | 44 |
| 17 | 5 44 | 54 16 | 84398 | 4 | 15602 | 98913 | 7 | 01087 | 14515 | 4 | 85485 | 43 |
| 18 | 5 36 | 54 24 | 84411 | 4 | 15589 | 98939 | 8 | 01061 | 14527 | 4 | 85473 | 42 |
| 19 | 5 28 | 54 32 | 84424 | 4 | 15576 | 98964 | 8 | 01036 | 14540 | 4 | 85460 | 41 |
| 20 | 6 5 20 | 5 54 40 | 9.84437 | 4 | 10.15563 | 9.98989 | 8 | 10.01011 | 10.14552 | 4 | 9.85448 | 40 |
| 21 | 5 12 | 54 48 | 84450 | 5 | 15550 | 99015 | 9 | 00985 | 14564 | 4 | 85436 | 39 |
| 22 | 5 4 | 54 56 | 84463 | 5 | 15537 | 99040 | 9 | 00960 | 14577 | 5 | 85423 | 38 |
| 23 | 4 56 | 55 4 | 84476 | 5 | 15524 | 99065 | 10 | 00935 | 14589 | 5 | 85411 | 37 |
| 24 | 4 48 | 55 12 | 84489 | 5 | 15511 | 99090 | 10 | 00910 | 14601 | 5 | 85399 | 36 |
| 25 | 6 4 40 | 5 55 20 | 9.84502 | 6 | 10.15498 | 9.99116 | 11 | 10.00884 | 10.14614 | 5 | 9.85386 | 35 |
| 26 | 4 32 | 55 28 | 84515 | 6 | 15485 | 99141 | 11 | 00859 | 14626 | 5 | 85374 | 34 |
| 27 | 4 24 | 55 36 | 84528 | 6 | 15472 | 99166 | 11 | 00834 | 14639 | 6 | 85361 | 33 |
| 28 | 4 16 | 55 44 | 84540 | 6 | 15460 | 99191 | 12 | 00809 | 14651 | 6 | 85349 | 32 |
| 29 | 4 8 | 55 52 | 84553 | 6 | 15447 | 99217 | 12 | 00783 | 14663 | 6 | 85337 | 31 |
| 30 | 6 4 0 | 5 56 0 | 9.84566 | 6 | 10.15434 | 9.99242 | 13 | 10.00758 | 10.14676 | 6 | 9.85324 | 30 |
| 31 | 3 52 | 56 8 | 84579 | 7 | 15421 | 99267 | 13 | 00733 | 14688 | 6 | 85312 | 29 |
| 32 | 3 44 | 56 16 | 84592 | 7 | 15408 | 99293 | 13 | 00707 | 14701 | 7 | 85299 | 28 |
| 33 | 3 36 | 56 24 | 84605 | 7 | 15395 | 99318 | 14 | 00682 | 14713 | 7 | 85287 | 27 |
| 34 | 3 28 | 56 32 | 84618 | 7 | 15382 | 99343 | 14 | 00657 | 14726 | 7 | 85274 | 26 |
| 35 | 6 3 20 | 5 56 40 | 9.84630 | 8 | 10.15370 | 9.99368 | 15 | 10.00632 | 10.14738 | 7 | 9.85262 | 25 |
| 36 | 3 12 | 56 48 | 84643 | 8 | 15357 | 99394 | 15 | 00606 | 14750 | 7 | 85250 | 24 |
| 37 | 3 4 | 56 56 | 84656 | 8 | 15344 | 99419 | 16 | 00581 | 14763 | 8 | 85237 | 23 |
| 38 | 2 56 | 57 4 | 84669 | 8 | 15331 | 99444 | 16 | 00556 | 14775 | 8 | 85225 | 22 |
| 39 | 2 48 | 57 12 | 84682 | 8 | 15318 | 99469 | 16 | 00531 | 14788 | 8 | 85212 | 21 |
| 40 | 6 2 40 | 5 57 20 | 9.84694 | 9 | 10.15306 | 9.99495 | 17 | 10.00505 | 10.14800 | 8 | 9.85200 | 20 |
| 41 | 2 32 | 57 28 | 84707 | 9 | 15293 | 99520 | 17 | 00480 | 14813 | 8 | 85187 | 19 |
| 42 | 2 24 | 57 36 | 84720 | 9 | 15280 | 99545 | 18 | 00455 | 14825 | 9 | 85175 | 18 |
| 43 | 2 16 | 57 44 | 84733 | 9 | 15267 | 99570 | 18 | 00430 | 14838 | 9 | 85162 | 17 |
| 44 | 2 8 | 57 52 | 84745 | 9 | 15255 | 99596 | 19 | 00404 | 14850 | 9 | 85150 | 16 |
| 45 | 6 2 0 | 5 58 0 | 9.84758 | 10 | 10.15242 | 9.99621 | 19 | 10.00379 | 10.14863 | 9 | 9.85137 | 15 |
| 46 | 1 52 | 58 8 | 84771 | 10 | 15229 | 99646 | 19 | 00354 | 14875 | 10 | 85125 | 14 |
| 47 | 1 44 | 58 16 | 84784 | 10 | 15216 | 99672 | 20 | 00328 | 14888 | 10 | 85112 | 13 |
| 48 | 1 36 | 58 24 | 84796 | 10 | 15204 | 99697 | 20 | 00303 | 14900 | 10 | 85100 | 12 |
| 49 | 1 28 | 58 32 | 84809 | 11 | 15191 | 99722 | 21 | 00278 | 14913 | 10 | 85087 | 11 |
| 50 | 6 1 20 | 5 58 40 | 9.84822 | 11 | 10.15178 | 9.99747 | 21 | 10.00251 | 10.14926 | 10 | 9.85074 | 10 |
| 51 | 1 12 | 58 48 | 84835 | 11 | 15165 | 99773 | 21 | 00227 | 14938 | 11 | 85062 | 9 |
| 52 | 1 4 | 58 56 | 84847 | 11 | 15153 | 99798 | 22 | 00202 | 14951 | 11 | 85049 | 8 |
| 53 | 0 56 | 59 4 | 84860 | 11 | 15140 | 99823 | 22 | 00177 | 14963 | 11 | 85037 | 7 |
| 54 | 0 48 | 59 12 | 84873 | 12 | 15127 | 99848 | 23 | 00152 | 14976 | 11 | 85024 | 6 |
| 55 | 6 0 40 | 5 59 20 | 9.84885 | 12 | 10.15115 | 9.99874 | 23 | 10.00126 | 10.14988 | 11 | 9.85012 | 5 |
| 56 | 0 32 | 59 28 | 84898 | 12 | 15102 | 99899 | 24 | 00101 | 15001 | 12 | 84999 | 4 |
| 57 | 0 24 | 59 36 | 84911 | 12 | 15089 | 99924 | 24 | 00076 | 15014 | 12 | 84986 | 3 |
| 58 | 0 16 | 59 44 | 84923 | 12 | 15077 | 99949 | 25 | 00051 | 15026 | 12 | 84974 | 2 |
| 59 | 0 8 | 59 52 | 84936 | 13 | 15064 | 99975 | 25 | 00025 | 15039 | 12 | 84961 | 1 |
| 60 | 0 0 | 6 0 0 | 84949 | 13 | 15051 | 10.00000 | 25 | 00000 | 15051 | 12 | 84949 | 0 |
| M. | Hour P. M. | Hour A. M. | Cosine. | Diff. | Secant. | Cotangent. | Diff. | Tangent. | Cosecant. | Diff. | Sine. | M. |

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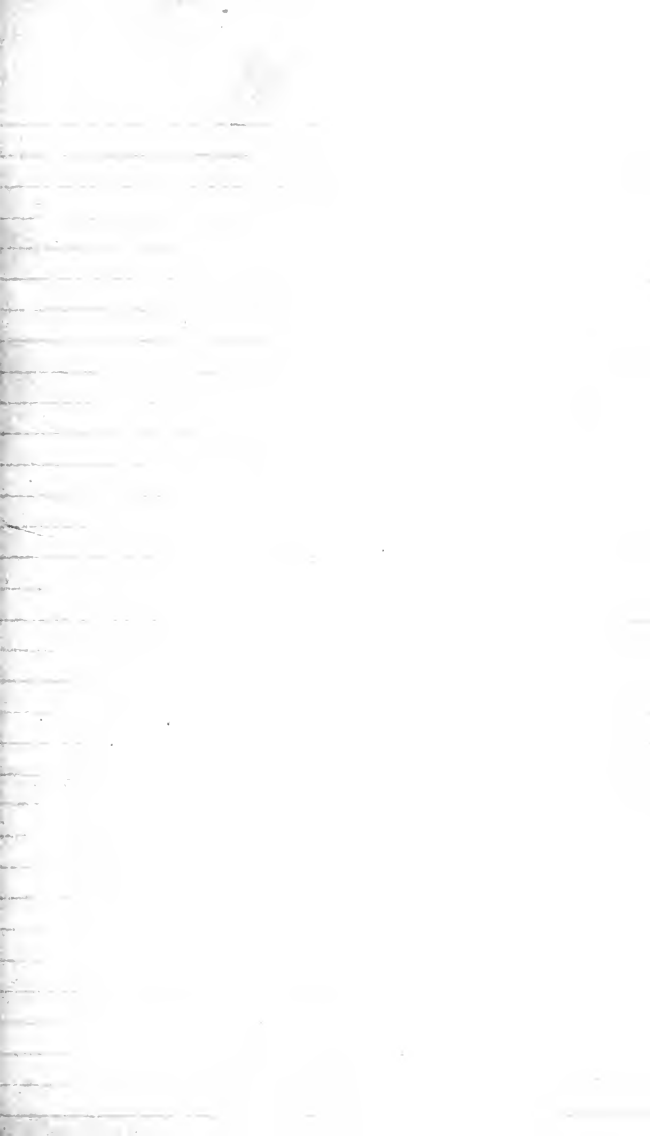






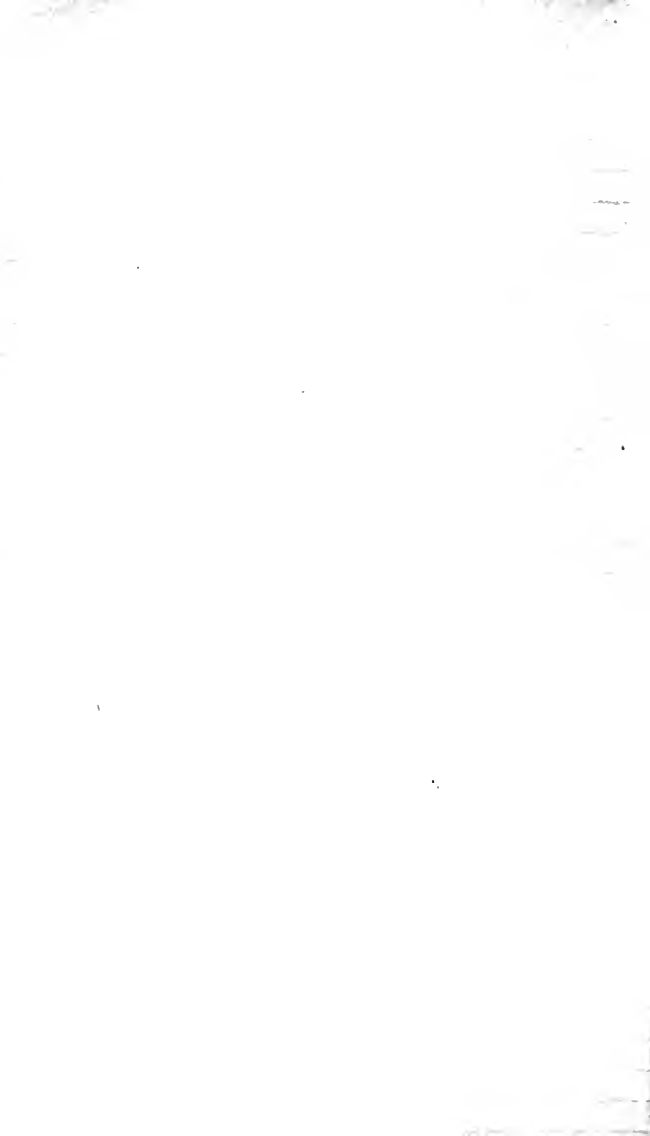


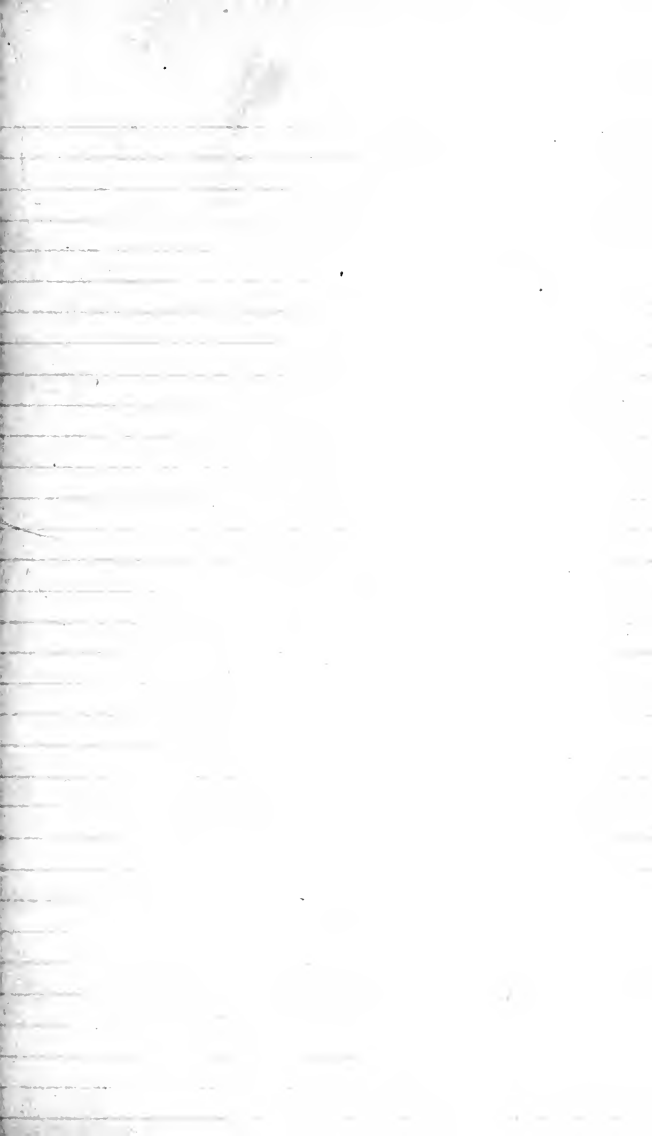




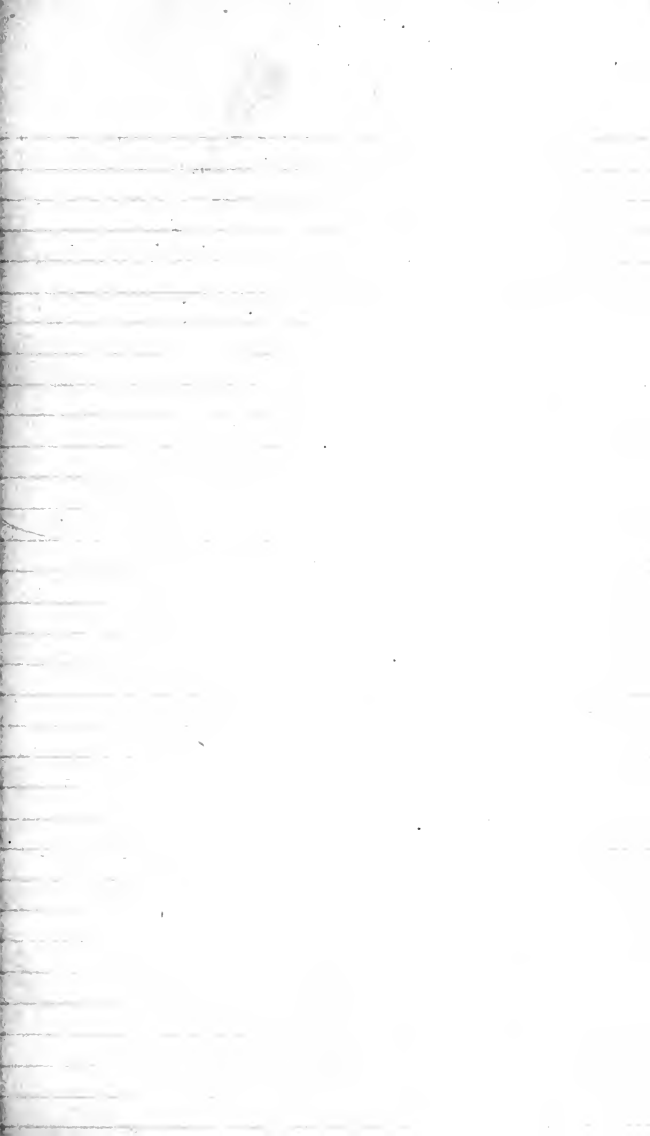






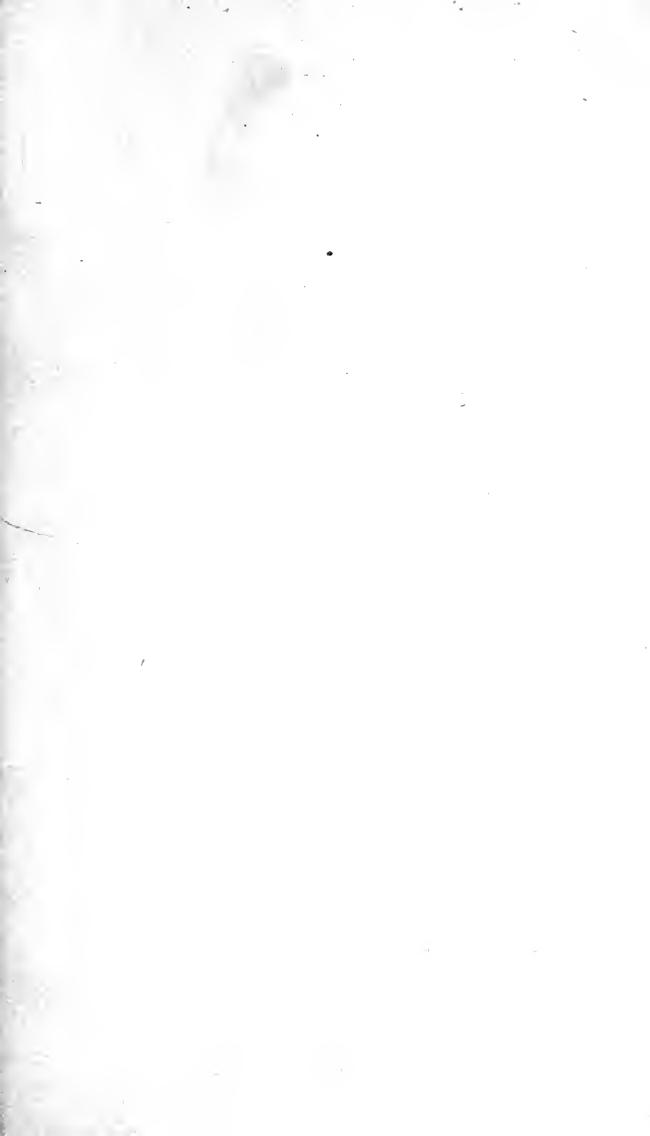


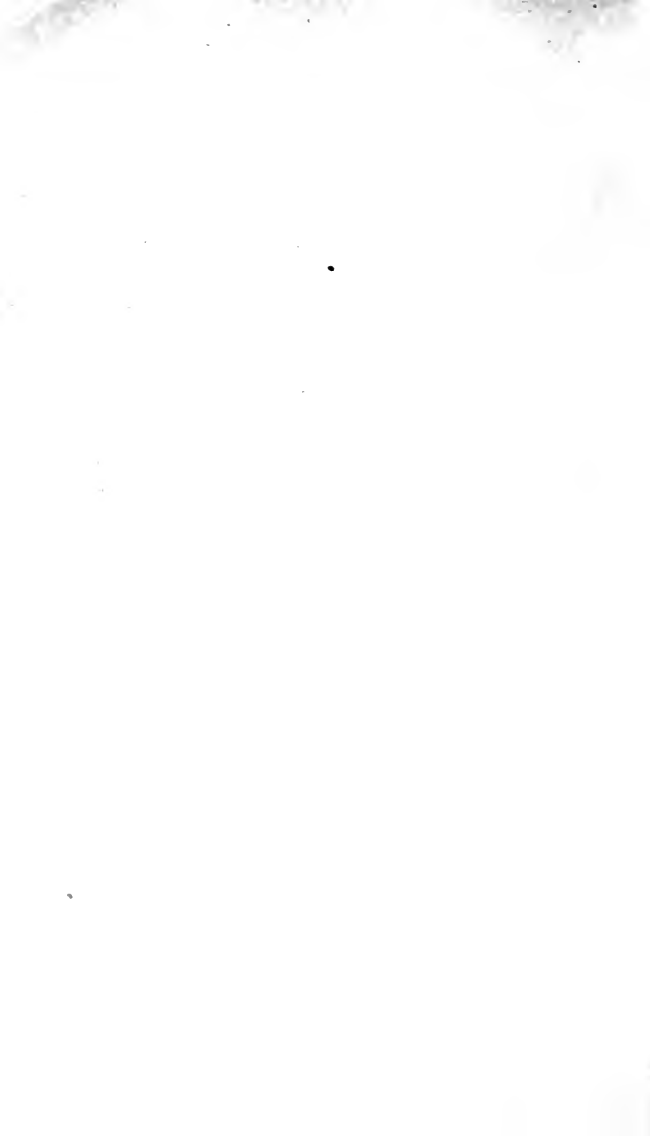












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